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AERONAUTICAL ENGINEERING REVIEW

MARCH 1944

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AERONAUTICAL ENGINEERING REVIEW

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March, 1944

VOLUME 3 NUMBER 3

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B-17 bomber inner wing sections move down the assembly line to the final assembly area at Lockheed Aircraft Corporation.

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Trail Blazing in the Skies

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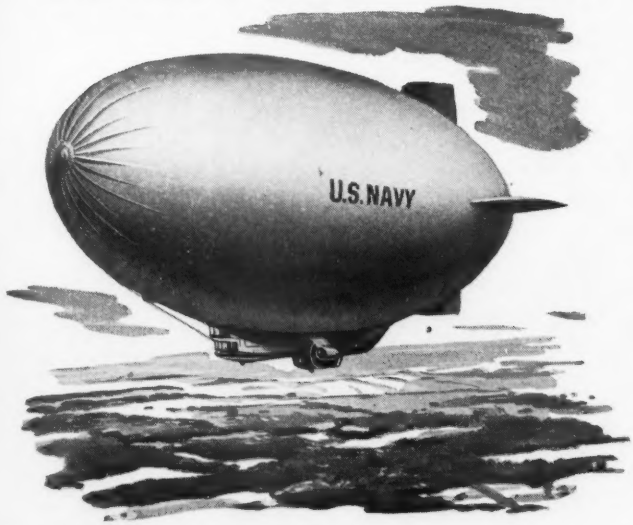

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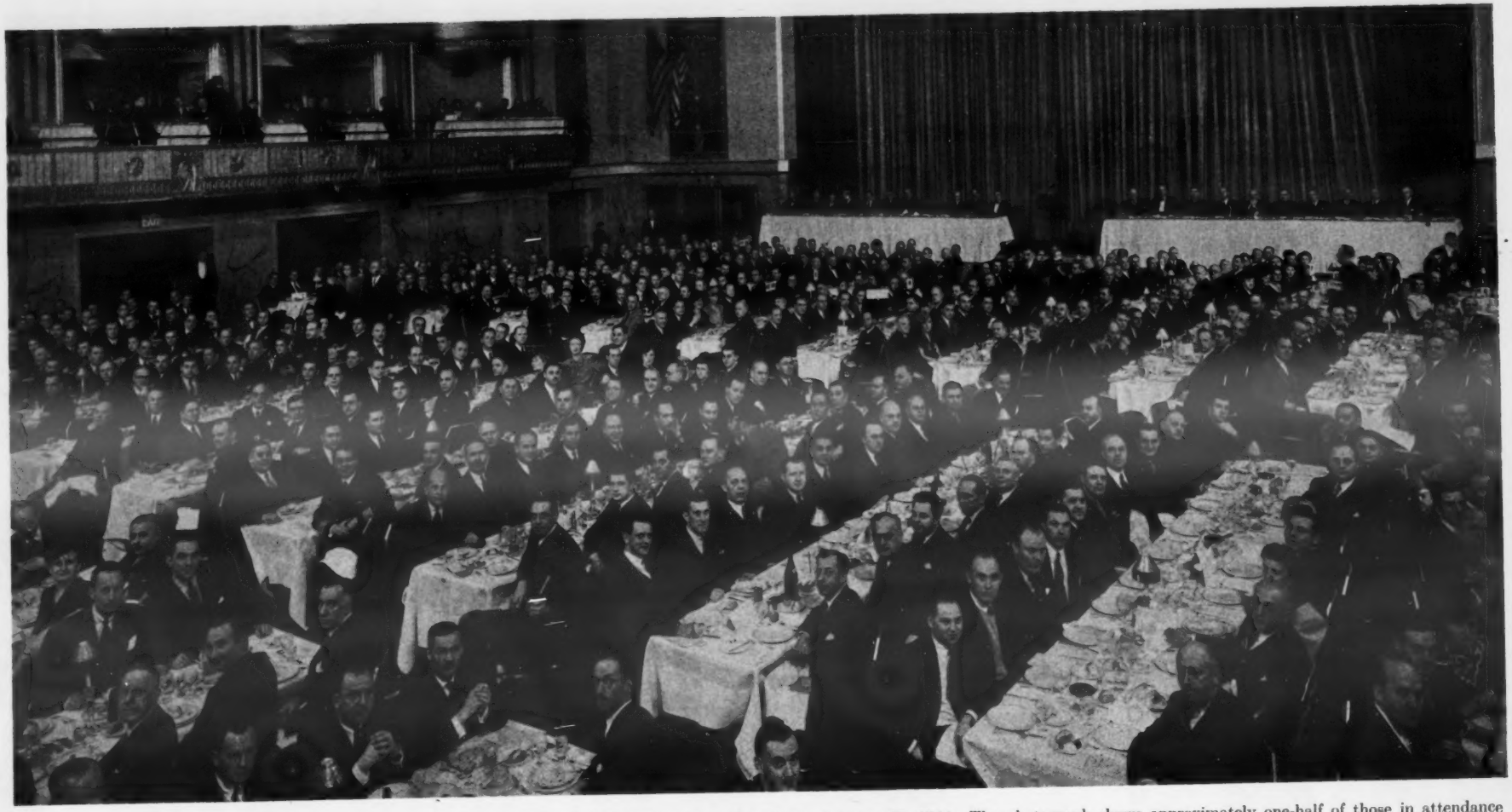

Honors Night Dinner, Institute of the Aeronautical Sciences, Hotel Waldorf-Astoria, New York, January 25, 1944. The photograph shows approximately one-half of those in attendance at the Dinner.

At the speakers' table (*left to right*) are: Dr. J. C. Hunsaker, Chairman, National Advisory Committee for Aeronautics; Charles L. Lawrance, President and Chief Engineer, Lawrance Aeronautical Corporation; Dr. Sanford A. Moss, Consulting Engineer, Supercharger Engineering Division, General Electric Company; Dr. Harry S. Rogers, President, Polytechnic Institute of Brooklyn; William B. Bergen, Chief Vibrations Engineer and Chief Flight Test Engineer, The Glenn L. Martin Company; Edward G. Sperry, Vice-President, Sperry Products, Inc.; Brig. Gen. Eugen G. Reinartz, Commandant, Army School of Aviation Medicine, Randolph Field; Brig. Gen. Frank P. Lahm (Ret.); Major Gen. F. O'D. Hunter, Commanding General, First Air Force, Mitchel Field; Dr. Hugh L. Dryden, Past-President of the Institute; Major R. H. Fleet, President of the Institute; Sir Richard Fairey, Director General of the British Air Commission; Col. H. F. Gregory, Matériel Command, Army Air Forces; Igor I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation; F. W. Reichelderfer, Chief, United States Weather Bureau; Lt. Col. Joseph J. George, Chief of the Special Studies Section of the Weather Division Headquarters, Army Air Forces; William H. McAvoy, Chief Test Pilot, Ames Aeronautical Laboratory, N.A.C.A.; C.S. Jones, President, Casey Jones School of Aeronautics; Capt. Luis de Florez, U.S. Navy; Dr. Louis Bauer, Consultant and Medical Examiner, C.A.A., and Editor-in-Chief, *Journal of Aviation Medicine*, Aero Medical Association.

Institute of the Aeronautical Sciences Honors Night Dinner

THE ANNUAL HONORS NIGHT DINNER of the Institute of the Aeronautical Sciences was held Monday, January 24, 1944, in the Grand Ballroom of the Hotel Waldorf-Astoria in New York City. The Dinner preceded the Technical Sessions of the Twelfth Annual Meeting of the Institute held at the Columbia University Pupin Physics Laboratories January 25, 26, and 27.

Over 1,000 members and guests attended the Dinner. This attendance was larger than at any previous Dinner.

The retiring President of the Institute, Dr. Hugh L. Dryden, Chief of the Mechanics and Sound Division of the National Bureau of Standards, acted as Toastmaster. Excerpts from the speeches of presentation and acceptance of awards follow. All salutations and expressions of appreciation have been omitted from this account.

Greeting by the President of the Institute

PRESIDENT DRYDEN: I bid you welcome to the Honors Night Dinner of the Institute of Aeronautical Sciences. This is an occasion for the presentation of honors and awards for achievement in the aeronautical sciences, for expressing appreciation to those who make these awards possible and for the simple purpose of good fellowship with old and new friends.

The Institute has had a most successful year. It has held many meetings. It has grown in membership. Its services have increased, as you will hear later. It has been fortunate in its gifts. The Institute has been at war. Probably no group of men has been so completely engaged in the war effort as those of the aeronautical sciences. When the history of the war effort can be told, the chapter describing the achievements of the members of the Institute will be outstanding.

Hugh L. Dryden.

Aeronautical engineers, production specialists, industrialists, military leaders, pilots, meteorologists, flight surgeons have been organized into one powerful team to make the United Nations supreme in the air and to win the war. In the peace to follow, the same cooperative spirit and hard work can bring to fruition the international air age.

General Grant is to present The John Jeffries Award. As you know, he is the Chief Air Surgeon of the Army Air Forces. His direction of the phenomenal expansion of the medical service has been an outstanding achievement. We can all be proud of his work in all parts of the world, looking after the health and physical welfare of our airmen. But he has not stopped there. He is developing a great program of rehabilitation for those men who have been incapacitated for their normal work.

Presentation of The John Jeffries Award

Honoring the memory of Dr. John Jeffries, an American physician who, with Blanchard the French balloonist, made the first aerial voyage across the English Channel in 1785 and on a previous voyage made the earliest recorded scientific observations from the air, this award was established by the Institute in 1940 to give recognition to the importance to aviation of scientific endeavor in the field of medicine.

MAJOR GENERAL DAVID N. W. GRANT: This Institute has always taken a great interest in the relationship of aviation medicine to the design, construction and operation of aircraft. At its technical meetings, it has invited the leaders in our profession to give the latest results of their investigations as they affect aeronautical engineering, and out of the discussions of these papers have come benefits to all of us.

The establishment of The John Jeffries Award was still another evidence of the Institute's recognition of the importance of the flight surgeon and medical research and the part they play in the development of the aeronautical sciences. I think the Committee of Award has shown great discernment in honoring the pioneers in aviation medicine. Usually the early work of such men goes unrecognized except by a few. You have given this award to men like Bauer and Armstrong and Schneider, who helped establish aviation medicine in this country.

Speaking for the Army Air Forces and for the Aero Medical Association, I congratulate you on your continued recognition of those of the medical profession engaged in aeronautical work. Tonight you are honoring another flight surgeon who has had a distinguished career in aviation medicine.

General Reinartz was commissioned a First Lieutenant of the Medical Corps of the regular Army December 12, 1917, and assigned to the Aviation Section of the Signal Corps. His service with aeronautics has been continuous since November 19, 1917. In fact, he has had longer continuous service with the A.A.F. than any other medical officer twenty-six years in all.

At the present time, General Reinartz is Commandant of the A.A.F. School of Aviation Medicine at Randolph Field, Texas, through whose portals all flight surgeons must pass.

Acceptance by General Reinartz

BRIGADIER GENERAL EUGEN G. REINARTZ: Since time immemorial, man has watched birds in flight and has expressed his wonderment in poetry and song and has marveled at the precision of their unerring flight. However, man is not biologically adapted by nature to such empyreal existence and must do mechanically that which the birds do naturally.

Nature in all her forms is harsh and man in his attempt to overcome nature in an element for which he is not fashioned is waging a battle which continually faces him with disillusion. Man's adaptability, however, has per-

Bureau; Lt. Col. Joseph J. George, Chief of the Special Studies Section of the Weather Division Headquarters, Army Air Forces; William H. McAvoy, Chief Test Pilot, Ames Aeronautical Laboratory, N.A.C.A.; C.S. Jones, President, Casey Jones School of Aeronautics; Capt. Luis de Flores, U.S. Navy; Dr. Louis Bauer, Consultant and Medical Examiner, C.A.A., and Editor-in-Chief, Journal of Aviation Medicine, Aero Medical Association.

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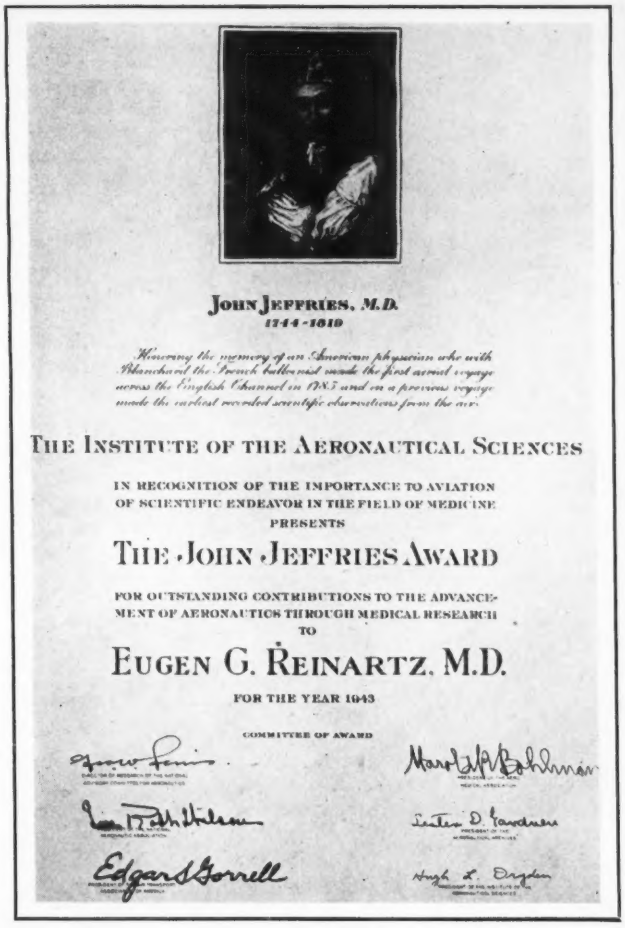
mitted him to do this successfully. Nevertheless, this mechanical adaptation creates stresses and strains that call for rapid adjustment to numerous situations, depending upon the degree to which man is physically and psychically able to adapt himself to his new task.

As difficulties appear, they naturally fall into the medical field and the practice of medicine has been most closely linked with aviation since its inception. One cannot discuss the one without telling the story of the other, at least in part. This is produced by the intimate relationship between certain basic principles of aviation medicine, the fact that the air crew plays such an important part, and the success in the design and operation of aircraft. In the development of the airplane as a peacetime instrument and as a wartime weapon, your organization has always been the forefront of aeronautical progress. Your interest and appreciation of the medical aspects of aeronautics are most commendable. This mutuality of interest is widened by the recognition by your Institute of pioneers and research workers in aviation medicine.

The office of the Air Surgeon of the Army with its aero medical research laboratory, the School of Aviation Medicine and the present Air Surgeon General Grant, particularly, alone with the Aero Medical Association, have kindled and kept burning the torch of research that will bring the answer to many of our perplexing problems.

As a flight surgeon, I have through the years dedicated myself to the advancement of aviation medicine, and as president-elect of the Aero Medical Association I pledge myself to the furtherance of these same aims in the larger field and to foster the excellent spirit of cooperation that exists between that Association and your Institute.


JOHN JEFFRIES, M.D.
1744-1819
Honoring the memory of an American physician who with Blanchard the French balloonist made the first aerial voyage across the English Channel in 1785 and on a previous voyage made the earliest recorded scientific observations from the air.
THE INSTITUTE OF THE AERONAUTICAL SCIENCES
IN RECOGNITION OF THE IMPORTANCE TO AVIATION OF SCIENTIFIC ENDEAVOR IN THE FIELD OF MEDICINE
PRESENTS
THE JOHN JEFFRIES AWARD
FOR OUTSTANDING CONTRIBUTIONS TO THE ADVANCEMENT OF AERONAUTICS THROUGH MEDICAL RESEARCH
TO
EUGEN G. REINARTZ, M.D.
FOR THE YEAR 1943
COMMITTEE OF AWARD

The Air Surgeon stated in a recent publication: In their quest for air supremacy, the aeronautical engineers have carried aircraft performance far beyond the natural tolerance limits of the human body. To make their planes humanly as well as technically practical, the engineers have formed a close partnership with the medical scientists.

Aviation and medicine are indissolubly wedded and may never be divorced. The scientists of both must, therefore, combine their efforts, as is evident tonight, in the solution of their mutual problems.

Major Gen. David N. W. Grant (*right*) congratulates Brig. Gen. Eugen G. Reinartz on receiving The John Jeffries Award for 1943.

PRESIDENT DRYDEN: The Institute's greatest honor is an honorary fellowship. This year we have selected an American and an Englishman. We are fortunate in having General Lahm to make the first presentation. He and General Arnold were true pioneers. They not only saw the birth of military aviation, but literally raised it through its youthful career. As you know, General Lahm was the first officer to fly with the Wrights. He was closely associated with General Arnold in the early days, as well as up to his retirement.

Unfortunately, General Arnold had a previous engagement for this evening and has asked Major General Hunter, Commanding General of the First Air Force, to receive the award and to respond for him.

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CARBURETORS AND ACCESSORIES

Presentation of Honorary Fellowship to General Arnold

Gen. H. H. Arnold.

BRIGADIER GENERAL FRANK P. LAHM: I am especially pleased at being designated to present Honorary Fellowship in the Institute of the Aeronautical Sciences to our country's No. 1 airman, my personal friend and associate of the past forty years.

Honorary Fellowship is the greatest of the Institute's honors. The recipient is selected by secret ballot of the 130 Fellows and must receive a three-fourths vote. Only one American may be selected each year. General Arnold deserves every honor that can be bestowed upon him. He pioneered in the true sense of the word. He was detailed to aviation duty by a War Department order of April 21, 1911, almost a third of a century ago. His aeronautical career started at Dayton, Ohio, where he learned to pilot an airplane under the guidance of its inventors, Wilbur and Orville Wright.

On completing his training at Dayton, he was ordered to the newly organized Signal Corps flying school at College Park, Maryland. After his arrival, with Lieutenant Milling who had trained with him at Dayton, the school comprised a total of five officers and fifteen enlisted men, but no airplanes. Two of the Wright type arrived before long and Lieutenant Arnold was assigned as a flying instructor. From then on, he was destined always to occupy positions of importance in military aviation, culminating in his appointment as its chief. Early in his career, he demonstrated his predilection for rising to great heights, by establishing an altitude record of over 3,260 feet, followed a few days later by a new record of 4,167 feet, quite a stunt in those days.

That same first summer he was responsible for a rather remarkable sensation in the national capital. The press had published the expected arrival of a civilian pilot who was to make a cross-country flight, starting in Massachusetts and ending at Potomac Park, to be followed by a special luncheon in honor of this sensational flight. One day in July, an airplane appeared over the city. The housetops and the trees were soon filled with spectators. Thousands rushed to the landing field. Senators deserted their seats in the midst of a roll call and the Vice-President of the United States ignored the speed laws to arrive in time. The luncheon guests were hastily summoned by telephone. But the airplane failed to land. It was Lieutenant Arnold on a practice flight from College Park, and it was only when he returned there that he learned of the commotion he had aroused.

General Arnold has fought for aviation throughout the long years of skepticism, for every new invention, every new weapon, must fight for recognition. His early, firm and unwavering belief in the future of air power has been a leading factor in developing the great air force we are fortunate to have today—the most powerful air force in the world. He has been instrumental in its growth from a stepchild of 1911, to the Aviation Section of the Signal Corps in 1914, to the Army Air Forces he now leads, some two and a half million men and thousands of airplanes, no longer an auxiliary weapon, but coequal with all the other arms of the service combined.

No other airman has been faced with the problems he has encountered in reaching this goal, and he has always found a solution for his problems. His judgment, his executive ability have produced this force which is carrying destruction to our enemies on a world front, undermining their morale and hastening the day when our fighting men may return to a United States at peace. We of the Institute are honoring General Arnold, but we feel also that he is honoring us in accepting this Honorary Fellowship.

Acceptance by General Arnold

MAJOR GENERAL F. O'D. HUNTER: General Arnold regrets he is unable to be here tonight with us, due to his duties as Commander of the Army Air Forces. He asked me to accept Honorary Fellowship in the Institute in his name and to read the following message from him:

"I am honored by the action of the Institute of the Aeronautical Sciences in naming me as an Honorary Fellow. I am sorry that I cannot be with you tonight to express in person my appreciation. It is an honor which I feel is bestowed not only on me, but through me on all members of the Army Air Forces, and particularly those who have worked hard and well in our scientific and engineering developments.

"Military men are sometimes supposed to regard such workers with scorn and suspicion. Professional soldiers are regularly reproached with being against innovation, with 'preparing for the last war,' with being quite ready to squander lives and risk defeat just as long as they can do it in the traditional or old familiar way. Personally I think these charges, even in the cases where the historical event seems to justify them, are less than just. The professional soldier, to whom the defense of his country is committed, is certainly likely to think twice before he abandons methods and weapons that have been long tried, tested and found good, in favor of the weapons and methods that are simply plausible on

Major Gen. F. O'D. Hunter (*left*) receives an Honorary Fellowship in the Institute for Gen. H. H. Arnold from Brig. Gen. Frank P. Lahm (Ret.).

No worry about courses, positions or landings need disturb the calm of the pilots who today handle the giant craft of the sky. They fly with confidence, sure in the knowledge that the science of radio will keep them safe on their courses and bring them safely to their airport homes.

Federal has been a chief contributor to safety in the air. Its developments in radio aids to navigation have marked some of the most important steps in aviation progress. Particularly has Federal anticipated the needs for the Ultra High Frequency Radio Range and Instrument Landing System and the trends in their design and operation.

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Today, Federal is the outstanding producer of radio aids to navigation for the war effort. Looking forward to the tremendous after-the-war growth of aviation, it is geared to keep pace with every demand and performance requirement for this equipment.

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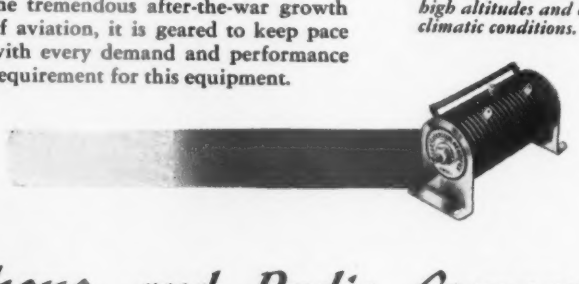

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paper or dubiously 'proved' by demonstrations under favorable conditions. He has too much at stake. The safety of his country and his own honor depend on his right judgment.

"We, in the Air Forces, have never been seriously accused of this alleged failing. Air Force men fought long and patiently, or even, impatiently, against great odds—in some instances, known to you, at the cost of an officer's career—for that risky innovation, air power. There was never any doubt in my own mind that the protagonists of air power were right and must in the long run win. I do not credit this to some extraordinary judgment or vision of mine. I think I may credit it to a just appreciation of the skill, intelligence, and courageous determination of those workers in the aeronautical sciences who every year improved and advanced the design and construction of the first flying machines. In their laboratories and wind tunnels, in their work shops and hangars, they were finding the answers to one after another of the difficulties that, long after flight had been proved possible, gave people the false impression that flight was impractical, that, from the military standpoint, the airplane was unreliable. I don't say the doubters were unreasonable. Their doubts were supported by many early failures and disappointments. They simply lacked, sometimes the interest, sometimes the opportunity, to know what the theorists and experimenters were doing, and so to see the shape of the inevitable things to come.

"These theorists and experimenters gave us the airplanes with which we have made the greatest air force the world has ever seen. The work that they, that many of you men here present, did was so thorough, so sound, and in its final fruits so good, that the world sometimes may seem to reward you with the supreme, if not perhaps entirely welcome, compliment of overlooking you. You work to make it possible for men to take flight for granted, and many of them certify the quality of the job by doing just that. At present public attention is naturally fixed on the skilled and spirited men who fly and fight these planes you made possible, on the devoted ground organizations that keep them in the air—air that, without vain glory or exaggeration we can call now, or soon will be able to call, our air in the many theaters where we operate. The public thinks, too, of the workers in the great plants who, with devotion, are turning the planes out by the thousands. It is not easy to remember that you are the ones to whom they largely owe this increasing, this soon to be crushing, power.

"In the Army Air Forces we do not forget it. We can and do train thousands of young men to fly. We know with what valor and resolution they will fight. We can and do build the swarms of aircraft which we must have to clear the skies. Yet in every flight, and particularly in every fight, we read large our debt to those aeronautical engineers who have seen to it that we are better than our enemies, not merely man for man, but plane for plane. This is the margin for victory. Without it, training, valor, any number of aircraft, could hardly give us the supremacy we must have. With it, we are going to win, and for this certain victory the Army Air Forces, and all America, have you to thank."

PRESIDENT DRYDEN: Now we are to honor our old friend of the Institute. His career has been climaxed by the work he has been doing in this country for the past two years. No one could present this honor better than T. P. Wright, former President of the Institute. We are proud of his distinguished record in Washington in connection with the aircraft production program.

Presentation of Honorary Fellowship to Sir Richard Fairey

MR. T. P. WRIGHT: The award of Honorary Fellowship in the Institute of the Aeronautical Sciences is made for outstanding achievement, for pre-eminence in some field of aeronautics and it is not lightly made.

Sir Richard Fairey justly deserves this award. He could qualify on a number of counts—in fact on any one of a number of counts. First, he is an inventor, having invented that very important feature of the airplane—the wing flap. For that he was awarded the Wakefield Gold Medal in England several years ago. Then, too, he might receive Honorary Fellowship on the basis of engineering achievement. The many designs which his company has turned out have had their origin in his brain. He might be awarded this honor as an industrialist. He has headed his own company for some thirty years. He might be awarded it as a public servant. He has given unstintingly to his country during the last few years in Washington.

Sir Richard started in aviation in 1906, where he showed his first interest in work on models. Then in 1912–1915 he became engaged entirely in aeronautics, in engineering—first, with the company manufacturing the Dunn Plane, a tailless model of the early days, and later as Chief Engineer of Short Brothers. Shortly after he left Shorts' he founded his own firm, The Fairey Aviation Company, Ltd. I know that you are all aware of the outstanding designs which that company has produced.

In Great Britain he has been recognized as a leader in aeronautics, as he was President of The Royal Aeronautical Society for two terms and was also Chairman of the Society of British Aircraft Constructors and a Member of the Aeronautical Research Committee. He has always been a very close friend of the Institute of the Aeronautical Sciences and some years ago started a fund in England which had as its objective the securing of British aeronautical books which are presented to the Institute to find a permanent place in our archives.

He is always at the head of the receiving line for any aeronautical-minded Americans who may visit England. His friendship with us, so far as my own personal knowledge is concerned, started in the old racing days in

Sir Richard Fairey (*left*) receives his certificate of Honorary Fellowship in the Institute from T. P. Wright.

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AIRCRAFT FINISHES

the early 1920's, when he made a couple of trips to this country. At that time, he became deeply interested in some of the aeronautical developments that he has seen and honored us by arranging to take several of them back to England. In 1941 he came to this country with the British Aircraft Commission and he is now Director-General of that body.

Several years ago when the Joint Aircraft Committee was formed in Washington, he was appointed one of the representatives of the British and he has remained there ever since, attending regularly and contributing greatly to all meetings. He has always been a strong advocate at those meetings of the requirements of the United Kingdom, but has at the same time dealt with us in a most sympathetic manner, showing complete understanding of the problems which we have had in building up our own air force.

For his outstanding contribution to his country, Sir Richard was knighted in 1942 by His Majesty, the King of England. To attain such real achievement and have it recognized both at home and abroad is really something of which he can be justly proud.

It is a great personal pleasure and privilege for me to represent the Institute of the Aeronautical Sciences in awarding to Sir Richard Fairey Honorary Fellowship.

Acceptance by Sir Richard Fairey

SIR RICHARD FAIREY: I should like to express my sincere gratitude, my deep appreciation of this great honor that has been conferred upon me, sentiments that I know The Royal Aeronautical Society of the United Kingdom will fully share. I might mention on this occasion that it is this month that The Royal Aeronautical Society attains its seventy-eighth Birthday.

It is a matter of great pride to be so intimately connected with a great institution such as this, which by its vigorous growth on its firm foundations manifestly assures itself of a permanent and ever more important place in its country and indeed the world, and one fully befitting the leading position that the aeronautical engineers of the United States have earned for themselves and for their country.

The American aviation industry has shown the world what it can do. Is it not a fact that this terrific program of production, aircraft, tanks, shipping, every munition of war, at whose astronomical figures we were gazing incredulously less than two years ago, has been achieved and with apparent ease, without even losing breath, without any noticeable effect on civilian economy and with such apparent facility as to suggest if it had to, American industry could do even more? And quality has risen even as production advanced.

Nontechnical prophets arise who raise public expectations to tremendous heights and then sit back quite confidently and wait for the engineer to do the work. Only the engineer knows by what hard degrees the conquest of the air has been achieved. Nevertheless, miracles do still happen. Only last year, two notable inventions, two great milestones on the road we travel, were announced—the practical helicopter of Mr. Sikorsky and Captain Whittle's jet-propulsion engine, our guarantees that we can look forward to keeping that technical superiority which stood us in such good stead in the days when we were so greatly outnumbered in the air and before American industry had tipped the balance in the Allies' favor.

Should we not concentrate on that aspect? The more we exploit the advantages of superior science and development, the better equipment we can supply the armed forces, the more we can save life and limb for the fighting men. Technical superiority is evidently the natural advantage of free civilized peoples; let's exploit it to the full.

I convey on behalf of The Royal Aeronautical Society its greetings and also its congratulations to its prodigious offspring, if I may so call the Institute of the Aeronautical Sciences.

PRESIDENT DRYDEN: In the early days of the Institute, Charles Lawrance was one of its mainstays. He was its second President and took it through the teething stage. As The Sylvanus Albert Reed Award has been awarded in the engine field this year, who could present it more fittingly than one of the pioneer engine designers of this country.

The late Dr. S. A. Reed, designer of metal aircraft propellers and a Founder Member of the Institute, made an endowment to the Institute in 1933 to provide an annual award with a certificate and honorarium of two hundred and fifty dollars. The recipient of this award is chosen by ballot of the American Honorary Fellows and Fellows of the Institute, who now number over a hundred of this country's leading aeronautical scientists.

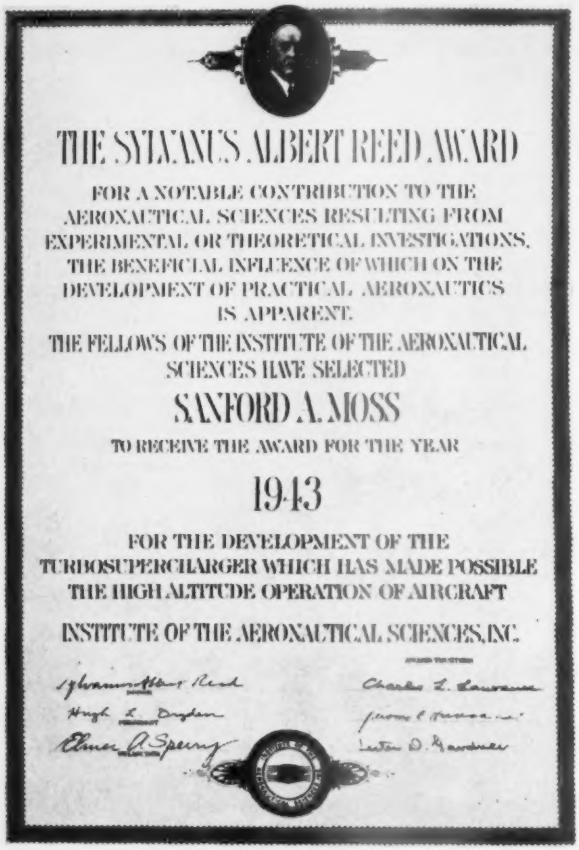
Presentation of The Sylvanus Albert Reed Award

MR. CHARLES L. LAWRANCE: A number of years ago, the Institute of the Aeronautical Sciences was very much honored by a gift by Mr. Sylvanus Albert Reed, who established a fund of $10,000 from the income of which we make an award every year in recognition of a notable contribution to aeronautical engineering which had actually been put to practical use.

The recipient of the award this year is well known to everybody in the aircraft industry. He has been working all of his life in the development of superchargers for aircraft engines. From the time of the first World War his supercharger work has been carried on and, of course, during the lean years since the last war, the amount of money that was available to carry on researches of this sort was unfortunately very small. Nevertheless, he persisted, and in 1940 he received the Collier Trophy jointly with the Army Air Force, for the development of the turbosupercharger.

Dr. Moss is a man of the highest scientific distinction. I feel that in awarding the Reed Award to him, we are selecting a man who richly deserves it.

Charles L. Lawrance (*right*) presents The Sylvanus Albert Reed Award for 1943 to Dr. Sanford A. Moss.



THE SYLVANUS ALBERT REED AWARD

FOR A NOTABLE CONTRIBUTION TO THE AERONAUTICAL SCIENCES RESULTING FROM EXPERIMENTAL OR THEORETICAL INVESTIGATIONS, THE BENEFICIAL INFLUENCE OF WHICH ON THE DEVELOPMENT OF PRACTICAL AERONAUTICS IS APPARENT.

THE FELLOWS OF THE INSTITUTE OF THE AERONAUTICAL SCIENCES HAVE SELECTED

SANFORD A. MOSS

TO RECEIVE THE AWARD FOR THE YEAR

1943

FOR THE DEVELOPMENT OF THE TURBOSUPERCHARGER WHICH HAS MADE POSSIBLE THE HIGH ALTITUDE OPERATION OF AIRCRAFT

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

Acceptance by Dr. Moss

Dr. Sanford A. Moss: Once upon a time "we" was a popular aviation word. It still is a very good word to include many of us who have been on war aviation since the early days, including old-timers in the Army, in the Navy and in the various commercial companies. Those of us included in this "we" nowadays are glad to feel that our efforts through many years are being recognized. The old days are over, and wartime aviation is being given an opportunity to play a much more important part in the present conflict than ever was dreamed of. However, there mustn't be complacency, but instead inspiration to merit even greater opportunities in the future. Although the early ideas that aviation warfare was of secondary importance have been superseded, even the most rabid aviation enthusiast must admit that there still have to be some ground troops and battleships. But perhaps the air may be the primary area of combat in the future.

We cannot rightly say that we are glad of the immense destruction now being wrought by aviation warfare, nor glad of our fulfillment of the prophecies made by Tennyson in 1842 of present-day stratosphere bombing and fighting:

> "And there rained a ghastly Dew
> "From the nations' Airy navies,
> Grappling in the central blue. . ."

But frightful destruction seems the shortest way to bring the matter to an end and to do the necessary damage to ruthless enemies with a minimum of expendables.

It is to be hoped that in the meantime we are laying foundations so that we soon shall have as great a boom in civil aeronautics as is now occurring in war aeronautics. But we must be broad-minded and unselfish and start the new era in transportation without the waste, scandal, selfishness and duplication of effort that ushered in the last transportation revolution when the railroad era began in the sixties. We have to be ruthless in war, but let's stop war when the war stops and make unselfish efforts for peace in civil aviation.

One very important part of the new aviation era is high-altitude warfare. When The Army Air Forces still were trying to get recognition, there began development of turbosuperchargers for this, late in 1917. The first actual high-altitude bombing was by General Billy Mitchell, with turbosuperchargers, off the Virginia Capes in 1923, at the then unprecedented altitude of 11,000 feet. Some Army Air Corps people, first at McCook Field and later at Wright Field, particularly must be commended for their vision of future possibilities. Even in days of failures and disappointments, they were sympathetic and determined that the supercharger development should proceed. It is due to their unfailing support that the project has gone so far in the present war.

President Dryden: The old saying about no one ever doing anything about the weather does not apply to the Institute. We did something about it. There has not been a technical meeting of the Institute which has not included its papers on meteorology. One of the Institute's awards is The Robert M. Losey Award to be presented tonight by the Chief of the Weather Bureau, Dr. Reichelderfer.

Presentation of The Robert M. Losey Award

Established in 1940, this award honors the memory of Capt. Robert Moffatt Losey, a member of the Institute and a meteorologic officer of the Air Corps, who was killed at Dombas, Norway, April 21, 1940, while serving as an official observer for the U.S. Army. He was the first officer in the service of the United States to die in the present World War.

Dr. F. W. Reichelderfer: This award commemorates the name of Capt. Robert M. Losey, the first American officer to lose his life in the present war. Captain Losey was a meteorologic officer of the Army Air Forces, a weather officer, as that plain-talking and hard-hitting organization characteristically calls its meteorologists.

There was something prophetic about Captain Losey's role as a military observer in Europe, even before we entered the war. The climax of his career was indicative of the prominence the weather and weather officers would attain in American plans and operations, first in the national defense program and later in the prosecution of the war.

You are accustomed to reading in the daily dispatches from Europe, Russia and the Far East that bad weather often intervenes to slow down or stop military activities or that favorable weather has been used as an ally to turn the battle to our advantage. You may have read someting of how the weather officer works in the active theaters of war and how he often is called upon to attend the councils of the mighty to contribute his knowledge of the atmosphere and its vagarious ways for whatever that knowledge is worth in making strategic plans and tactical decisions.

These are great days for the meteorologist. Never before has he received half so much attention or half so much support. Significantly, never before has he had so much expected of him. In fact, he is frequently asked to

The B.F. Goodrich Airplane of the month

PIPER "GRASSHOPPER"

Far cry from the helpless balloons of the last war, this war's "eyes of the artillery" are highly maneuverable radio-equipped Piper "Grasshoppers." Wartime version of the famed Piper "Cub," it carries keen-eyed observers right over enemy positions where they can call the shots and get them on the target fast. These "flying jeeps" get under cover fast, too, when the occasion arises. The ability to set down on a small field or on a highway is just one of this versatile little plane's *big* advantages. And artillery spotting is just one of its many *big* war jobs.

B. F. Goodrich—makers of Airplane Silvertowns, Expander Tube Brakes, De-Icers, Bullet-Sealing Fuel Cells and many other essential aircraft products—salutes the men and women of Piper Aircraft Corporation who build the "Grasshopper"—our choice as "Plane of the Month."

In war or peace

B.F.Goodrich

FIRST IN RUBBER

. . . . PROGRESS REPORT ON AIRPLANE TIRES OF SYNTHETIC RUBBER . . . . .

The use of synthetic rubber has now been extended to airplane tires in all sizes and for nearly all types of service. A concise report on how these tires compare with natural rubber is not practical, because the proportion of synthetic varies from size to size. In some tires 70% of the rubber used is synthetic; in others only 35%. All-synthetic test tires have been made. The conversion to synthetic rubber was first limited to substituting synthetic rubber in the tread stock, and this was followed in many sizes by using increasing amounts of synthetic rubber in the carcass as well.

Airplane tires have some inherent qualities that make them more easily adaptable to synthetic rubber than tires for other types of service. For example, airplane tires have been held to a minimum thickness of carcass and tread, in the interest of weight control, and this has proved an advantage in controlling the greater temperature rise in synthetic rubber tires.

As tires for the various services have been released, their dependability and safety, under proper care, has been assured by exhaustive laboratory and service tests. Their service life, on the other hand, is not so easily determined. Only months of record-keeping and careful checking can provide the accumulation of evidence necessary to evaluate synthetic tires in terms of life expectancy. Reports from early airline tests are indicative of what may be expected, however, and performance figures so far accumulated do not show any radical modifications in such important qualities as tread wear, bruising, cutting resistance and weight.

The B. F. Goodrich log of experience in synthetic materials covers years of research and leadership in the development of many special-purpose rubbers. In June, 1940, passenger car tires in which more than half the rubber was B. F. Goodrich synthetic (Ameripol) were sold to American motorists. These were the first synthetic rubber tires offered for sale in America.

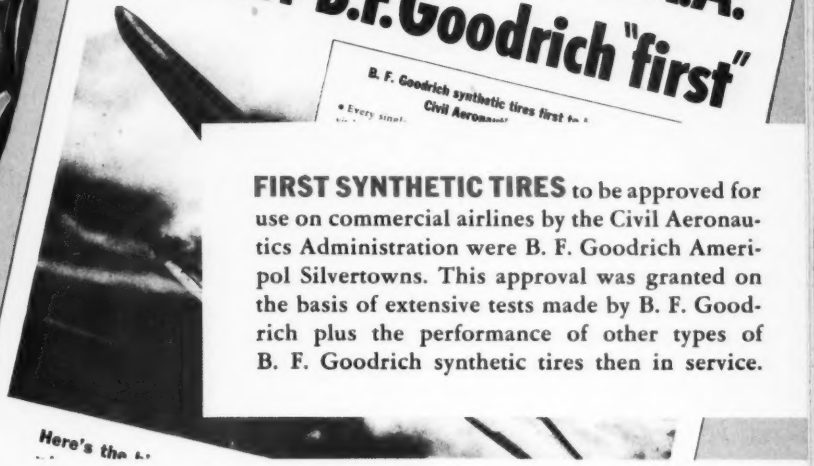
This background of experience, along with reports on both laboratory and field tests on airplane tires, led to the approval, by the Civil Aeronautics Administration in March, 1943, of synthetic B. F. Goodrich Silvertowns for commercial air lines.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

Awards to 9 plants

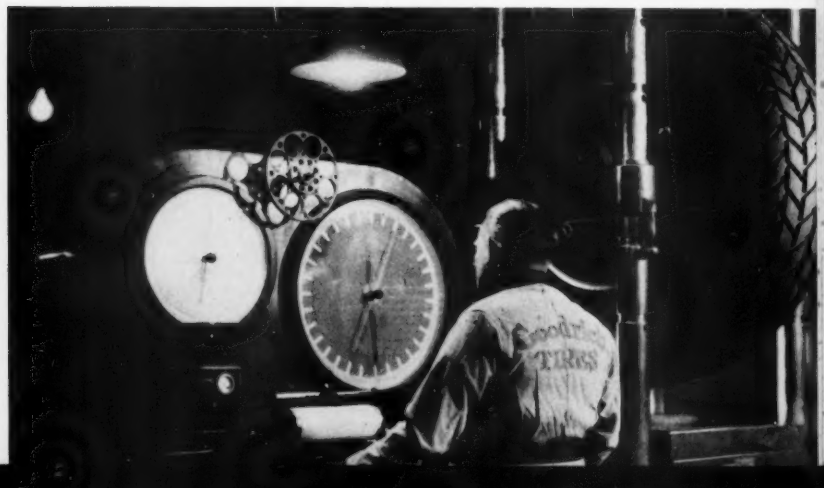
NEW SYNTHETIC RUBBER BOMBER TIRE with unusual non-skid tread design. This is one of many types of all-synthetic or partially synthetic tires now coming off B. F. Goodrich production lines.

SYNTHETIC TIRES for planes OK'd by C.A.A. Another B.F.Goodrich "first"



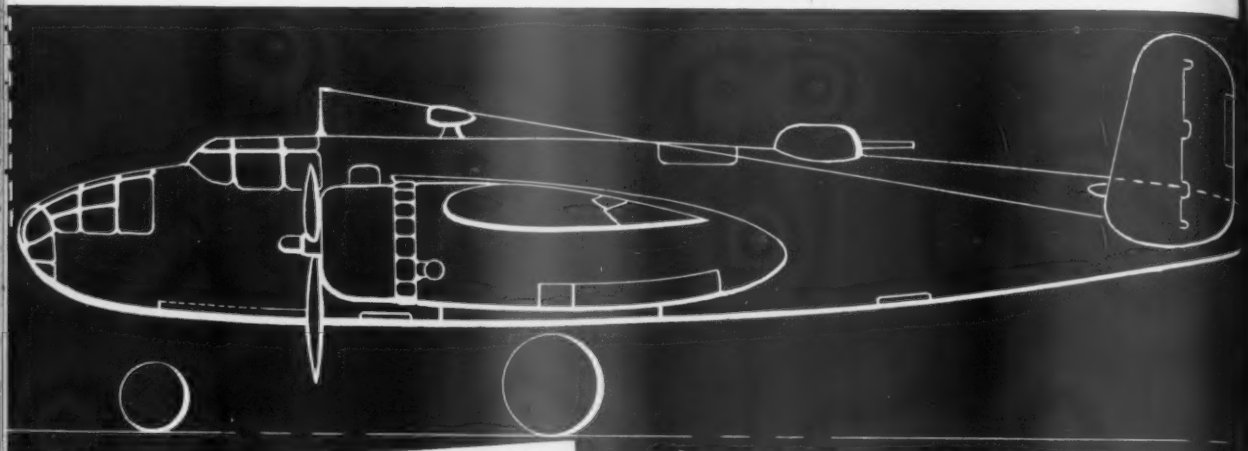
FIRST SYNTHETIC TIRES to be approved for use on commercial airlines by the Civil Aeronautics Administration were B. F. Goodrich Ameripol Silvertowns. This approval was granted on the basis of extensive tests made by B. F. Goodrich plus the performance of other types of B. F. Goodrich synthetic tires then in service.

OUR TORTURE CHAMBER TESTS help tell in advance how synthetic rubber tires will perform in service. The huge road wheel on the machine at the left simulates landing and take-off speeds up to 150 miles per hour. The number of landings of given loads at various speeds can be determined here with considerable accuracy. Below is a test for bruise-resistance.



For FASTER FASTENING

from nose to tail



A FEW TYPICAL APPLICATIONS OF THESE UNIQUE FASTENERS

- For attachment of plastic in nose and turrets.
- In cloth-covered wings, ailerons, rudders, elevators and trim tabs.
- Fastening fillets and fairing.
- Fastening flooring in plane or on work platforms.
- Fastening bonding wires.
- Fastening clips, brackets, etc. for conduits.
- Attachment of insulation and upholstery.
- Building light frames.
- Spacers for soundproofing and insulation.

Use B. F. Goodrich RIVNUTS

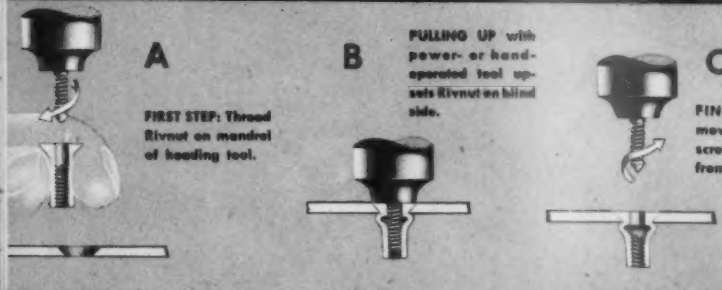
as Blind Rivets or Nut Plates or both!

The list at the left points out a *few* of the places B. F. Goodrich Rivnuts can be used to speed airplane assembly and cut costs. There are many more. In fact, on acquaintance with this unique fastener, you could probably make a new list of uses just as long for your own assembling operations.

Rivnuts combine light weight with strength; simplicity of design with low cost; easy installation with efficient performance. They have a wider bearing area than any other blind fastener, yet are compact and fit a smaller hole. All these advantages, and many others, can work to *your* advantage in airplane construction.

Our manufacturing capacity has been expanded so that we can fill all normal orders without delay. Get complete facts now by writing to The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio.

RIVNUT INSTALLATION IS AS EASY AS . . .


A
FIRST STEP: Thread Rivnut on mandrel of heading tool.
B
PULLING UP with power- or hand-operated tool upsets Rivnut on blind side.
C
FINAL STEP: Remove tool by unscrewing mandrel from upset Rivnut.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

F. W. Reichelderfer (*left*) congratulates Lt. Col. Joseph J. George on receiving The Robert M. Losey Award for 1943.

do the impossible. But if he has not yet become omniscient or able to see infinitely and infallibly into the future, he is at least doing his best to push back the frontiers of the most complex of physical sciences. Progress has not been spectacular but there has been some progress and there will be more, thanks to the active support of the Army, the Navy, and the civil interests of the United States and their recognition of the potential values in weather science.

I am sure that not one of you who is an aeronautical engineer or an operator or a pilot will object to the statement that we need greater exactness, greater accuracy in meteorology. We have recognized this fact for many years, have talked much about it and have worked to make the science more objective and more methodical, especially in weather forecasting, the aspect of meteorology of greatest import to aeronautics. There are a few meteorologists who have had some success in their attempts to systematize forecasts, and it is fitting that we honor one of the most successful of these tonight.

Lieutenant Colonel George would be the first to disclaim that he had found a method for telling exactly what the weather will be far in advance. He is too modest to tell much about what he has done. The important point is that he has actually done something about a systematic method for short-range forecasting, and by this pioneering he has stimulated others to work toward practical methodology in weather forecasting. The result has been progress and increased usefulness in applied weather science.

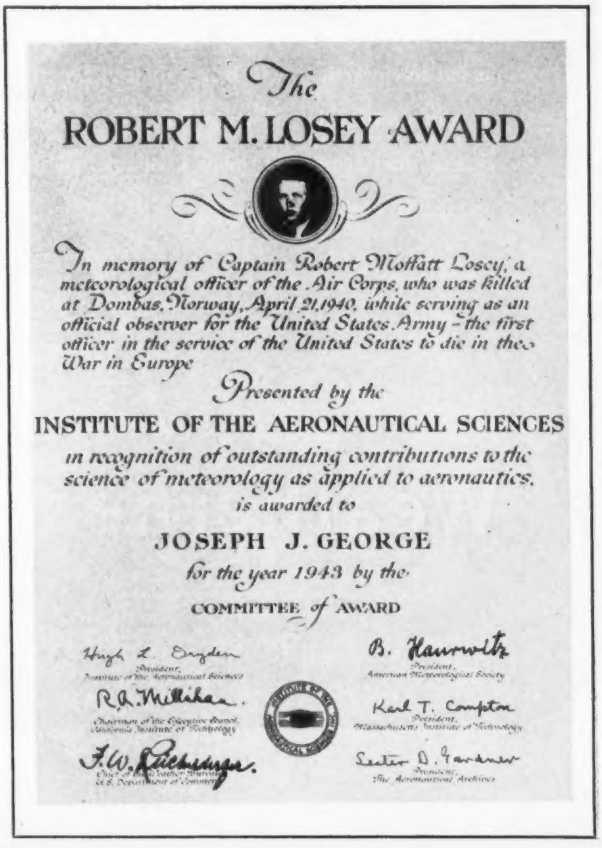
Acceptance by Lieutenant Colonel George

LIEUTENANT COLONEL JOSEPH J. GEORGE: The factor which has most inhibited the progress of meteorology as a science has always been the inability of man to reproduce the large-scale atmospheric reactions under controlled laboratory conditions. The effort required to convert the whole atmosphere to a laboratory is enormous. It has required the exacting demands of a war to produce such an attempt.

Today all over the world the weather services of the United Nations are acquiring information which certainly will unlock the doors to knowledge that heretofore has been inaccessible. The result of these efforts has been to give us a truly global viewpoint of weather processes. For example, we have learned that the interchange of air between the Northern and Southern hemispheres over the Dutch Indies may profoundly affect the weather next week over Oklahoma. The irregularity in the current at 20,000 feet over China can be reflected in anomalies over New York.

The final answer has not been written but until this extended viewpoint was attained, we could only toy with the isolated gears of weather and never have a picture of the whole machine. Most of the work now being done in meteorology is in the interests of aeronautics. Even before the war, the expansion of aviation forced weather people to accelerate their pace, and for the first time seriously consider the free air as well as its results upon the surface weather.

The list of research and development activities projected since war was declared is long and impressive, especially so when compared with the list of projects during the decade preceding the war. It is not yet time to present details of this progress, but certain trends can be discussed. The problem of extending the range of accurate forecasts which was tackled by the U.S.



The
ROBERT M. LOSEY AWARD

In memory of Captain Robert Moffatt Losey, a meteorological officer of the Air Corps, who was killed at Dombas, Norway, April 21, 1940, while serving as an official observer for the United States Army - the first officer in the service of the United States to die in the War in Europe

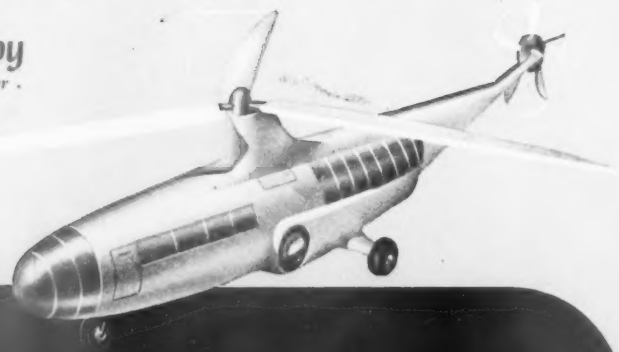
Presented by the
INSTITUTE OF THE AERONAUTICAL SCIENCES
in recognition of outstanding contributions to the science of meteorology as applied to aeronautics,
is awarded to
JOSEPH J. GEORGE
for the year 1943 by the
COMMITTEE of AWARD

Hugh L. Dryden, President, Institute of the Aeronautical Sciences
B. Haurwitz, President, American Meteorological Society
R. A. Millikan, Chairman of the Executive Board, California Institute of Technology
Karl T. Compton, President, Massachusetts Institute of Technology
F. W. Reichelderfer, Chief of the Weather Bureau, U.S. Department of Commerce
Lester D. Gardner, President, The Aeronautical Archives

I PREDICT...

by Raymond Loewy

Noted Industrial Designer



After the war you will travel more than you ever have. And one of the developments that will make it possible is the new helicopter air bus. This remarkable aeronautical achievement ushers in a really new mode of transportation that will enable you to make short air trips quickly, inexpensively and in complete comfort. Present bus terminals will be adapted as landing ports and maintenance hangars so you will take off and arrive in central sections of cities and towns. The multi-passenger helicopter air bus, already endorsed by authorities as entirely practical, will bring air travel to millions of persons and thousands of communities that now lack this form of transportation. When you buy War Bonds today remember they will enable you to experience this and many other marvels in tomorrow's world!

Note: The Weatherhead Company, one of the oldest and most important manufacturers of parts for the aviation industry, is prepared for the day when its four plants will again be contributing to aviation's peacetime needs.

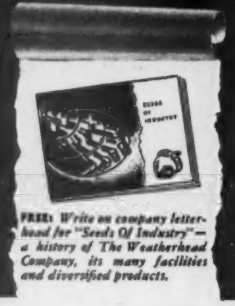
Look Ahead with ⟨W⟩

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario



***FREE:** Write on company letterhead for "Seeds Of Industry"—a history of The Weatherhead Company, its many facilities and diversified products.*

Weather Bureau, the Massachusetts Institute of Technology and the California Institute of Technology before the war has received concentrated attention from the air forces. It seems definite that U.S. forces are now at least equal, and probably superior, to the enemy in this regard, though we are far from satisfied. We can say that all possible avenues of attack on the problem have been or are being investigated, that definite progress has been made, and that if final perfection is attained, we will attain it before the enemy.

A recent application of these new techniques involving a very extensive historical weather map project which was compiled by the U.S. Weather Bureau with assistance from the Army and the Navy is of considerable interest in this regard.

The use of this material enabled the Eighth Air Force to schedule a mission into occupied France against targets of first priority which had not been suitable for visual bombardment for the past sixty days. Conventional methods of forecasting had failed to give the assurances that such a mission could be scheduled. The targets were hit. The weather was as forecast and the targets were removed from the priority list.

The trend of research forced by aeronautics to higher altitudes even before the war has been aggressively carried on since and for the same reason it is certain that increased importance will be attached to work at levels which we now think of only academic importance. This means that our already extended horizontal viewpoint will be stretched vertically as well, and, further, it means that skill in forecasting will be increased vastly over present levels not only in the cause of aeronautics but also for commercial and agricultural interests.

PRESIDENT DRYDEN: Now we come to a part of the program which is always looked forward to as a period of relaxation—Casey Jones, farmer, educator and a great pilot, has a way with him. When pilots get together, something usually happens. When one pilot presents an award to another, anything may happen.

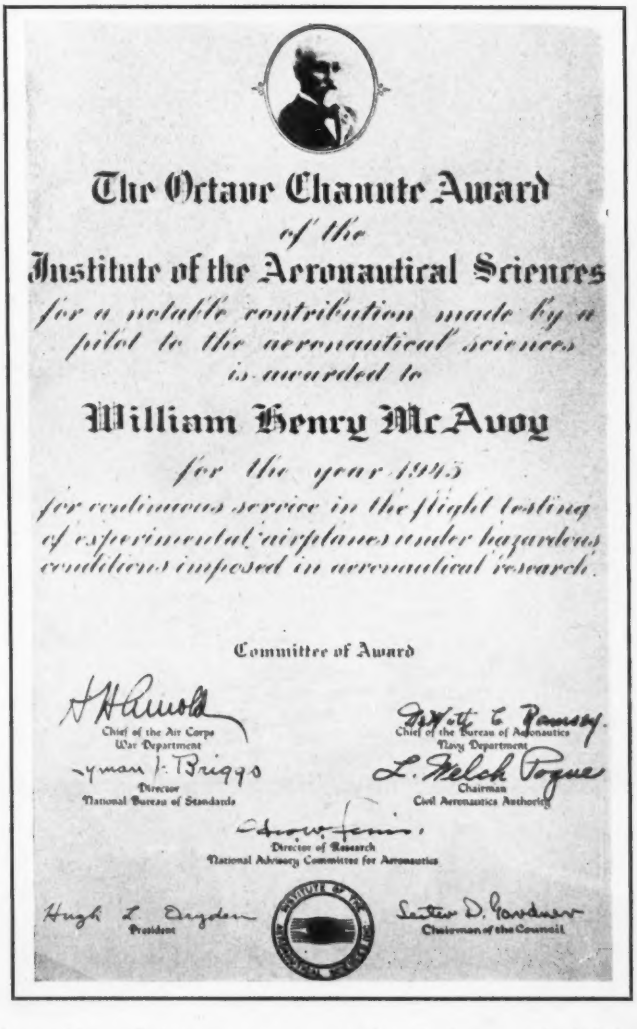
Presentation of The Octave Chanute Award

This award was established by the Institute in 1939 to honor the memory of Octave Chanute, pioneer American aeronautical investigator, who died in 1910.

MR. C. S. JONES: I want to congratulate the audience tonight. You have certainly done a lot better than in past years. Maybe the speaking has been better.

We are honoring tonight Bill McAvoy, who is one of our old-time pilots. He has got the same motto I have had for years. I would rather be the oldest pilot than the best one. For twenty-one years he has been the chief test pilot, or the test pilot for the N.A.C.A. In honoring him tonight, we are honoring pilots throughout the world, because, after all, we can have our engineers, we can have our weather, we can have everything, but the men who are going out and doing the job are the pilots and the flight crew and those are the fellows that are going to be wondering what it is all about when they come back.

In presenting you with this tonight, I am doing so with the hope that we in the industry have the brains and the intelligence to really set up an industry that will be waiting for them when they come back.


The Octave Chanute Award
of the
Institute of the Aeronautical Sciences
for a notable contribution made by a pilot to the aeronautical sciences is awarded to
William Henry McAvoy
for the year 1943
for continuous service in the flight testing of experimental airplanes under hazardous conditions imposed in aeronautical research.
Committee of Award
Chief of the Air Corps War Department
Chief of the Bureau of Aeronautics Navy Department
Director National Bureau of Standards
Chairman Civil Aeronautics Authority
Director of Research National Advisory Committee for Aeronautics
President
Chairman of the Council

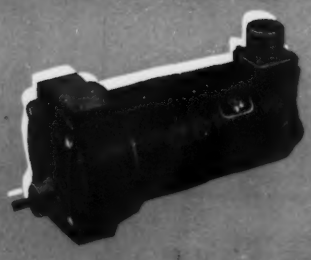
Acceptance by Mr. McAvoy

MR. WILLIAM H. MCAVOY: There have been so many instances of unusual accomplishments in the field of flight testing and research in the past few years that I feel that the part I have played is relatively a very minor one.

However, as stated in the citation, this award has been given me for continuous service in the flight testing of airplanes under hazardous conditions imposed in aeronautical research.

I am very thankful that I have survived long enough to be here tonight. While there is no direct implication in the award wording, there appears to be a "suspicious" between the lines, a suggestion that bears on the matter of old age and possibly a flight test moratorium. If anyone here tonight has received this impression, I would like to remind him that as an employee of the civil service, it is customary for Government test pilots to anticipate retirement at the age of sixty-two years, this concession of a lower age limit being made to a pilot on account of his hazardous occupation.

During my service with the N.A.C.A., I have been very closely associated with the personnel of the flight operations and the maintenance groups connected



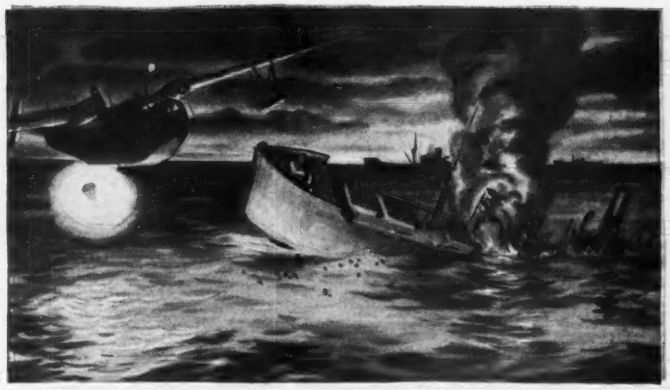
Special Dumore Aeromotor for Aerial Camera. Magnetic clutch and brake, stops output shaft in 2.5 revolutions.

Ammunition Booster motor for bomber turrets. Overrunning clutch permits free wheeling for belt loading.

Intercooler door motor, for supercharged high altitude flyers. Built in magnetic brake provides quick stopping.

T FOR THE NIGHT FIGHT

"Cover of darkness" is scant protection for prowling "Wolf-packs" or sneak movements of Nip-ships, since PBM's are equipped to drop flares with an accuracy matching their gunfire or bombing. Flare release mechanisms on Martin "Mariner" patrol-bombers are actuated by Dumore Aeromotors specially designed for this task.



"Specially designed" characterizes every Dumore Aeromotor, in keeping with the concept of a motor as a power unit. Beyond the capacity to operate efficiently under adverse conditions, Dumore engineering has given these motors ingenious operating controls that make their functions largely automatic. These motors "almost think!" Brakes, clutches, position-indicating potentiometers, overload protection, as well as various types of gear units—all such accessories are made part of the motor, and are products of the same high quality engineering.

Dumore Aeromotors are outstanding examples of engineering skill, coupling small size and lightweight with ample power and rugged dependability. Extremes of cold and heat, humidity, low atmospheric pressure, presence of explosive gases or corrosive fumes and constant vibration are met and overcome by special features of construction.

Read the full details about these "pace-setting" aviation motors in the Dumore Aeromotor Catalog. Send for your copy, today. The Dumore Company, Motor Division, Dept. MC10, Racine, Wisconsin.

NEW FLARE RELEASE MOTOR FOR MARTIN "MARINER"

New Flare Release Motor, Model No. 1002-203 Type E2L. (Specifications—h.p., .01; speed, 100 r.p.m.; torque, 6-lb.-inches.) Used on Martin PBM-3 "Mariner" to release parachute flares. Special requirements met by this motor are high starting torque to break any ice that may be on the flare chute door; low overrun to prevent recycling and the dropping of a second flare; small size, a Dumore principle; and like all Dumore Aeromotors, conditioning for operation in high altitudes and under extremes of temperature.

FOR *Extra* POWER HOURS

DUMORE

HEADQUARTERS FOR
FRACTIONAL HORSEPOWER MOTORS

STANDAIR PRESSURE CONTROLS INCREASE THE ENGINE EFFICIENCY IN MANY MAKES OF ALLIED AIRCRAFT

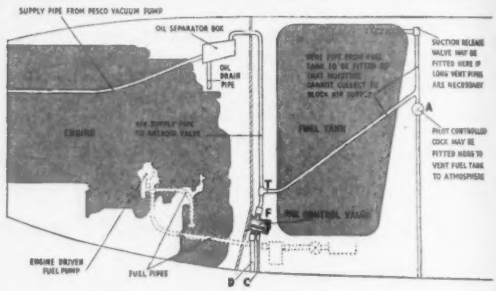
STANDARD

FUEL TANK PRESSURE CONTROL VALVE

Model FAZ

Weight 1 lb., 2 oz. *Overall Dimensions 4¼" x 5".*

The FAZ Pressure Control Valve is intended for the purpose of maintaining positive pressure in aircraft fuel systems under all flight conditions. Its mechanism includes a safety release in the event excessive pressure is generated in the fuel tank and also compensates for vacuum release.

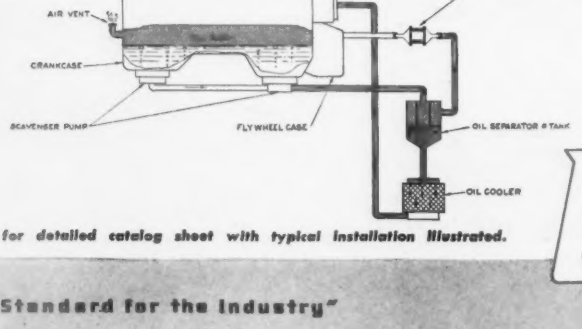

SUPPLY PIPE FROM PESCO VACUUM PUMP
OIL SEPARATOR BOX
OIL DRAIN PIPE
ENGINE
AIR SUPPLY PIPE TO AIR-IRON VALVE
FUEL TANK
SUCTION RELEASE VALVE MAY BE FITTED HERE IF LONG VENT PIPES ARE NECESSARY
PILOT CONTROLLED COCK MAY BE FITTED HERE TO VENT FUEL TANK TO ATMOSPHERE
ENGINE DRIVEN FUEL PUMP
FUEL PIPES
A
B
C
F

Write for detailed catalog sheet with typical installation illustrated.

OIL TANK VENT VALVE

Weight 14 oz. Diameter 2¼". *Overall Length 5½".*

A double action spring loaded valve to be used in the air vent line from oil separator to engine wheel case. Pressure is imposed in oil separator and tank preventing cavitation—to minimize air laden oil returning to oil pump—to increase oil pump efficiency. Provided with vacuum valve to prevent negative pressure (vacuum) developing in oil tank.



Write for detailed catalog sheet with typical installation illustrated.

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STANDARD AIRCRAFT PRODUCTS, INC.

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Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas

William H. McAvoy (*left*) receives congratulations from C. S. Jones on receiving The Octave Chanute Award for 1943.

with our flight research organization, and I am fully convinced from past experiences that the successful termination of many hazardous flights has in a major way been made possible by the intelligent cooperation and faithfulness with which these men have attended to their duties.

PRESIDENT DRYDEN: The Lawrence Sperry Award for young men was established by the sister and the brothers of Lawrence Sperry, with an endowment which provides the recipient with an honorarium. We have asked Mr. Edward Sperry to present this award tonight.

Presentation of The Lawrence Sperry Award

This award was endowed in 1936 by the brothers and sister of the late Lawrence Sperry, pioneer aviator and inventor who died in 1923 at the age of 31. It provides an annual certificate of citation and honorarium of two hundred and fifty dollars to the recipient selected by the Board of Award.

MR. EDWARD G. SPERRY: Mr. Bergen has been chosen to receive The Lawrence Sperry Award tonight for his work in the "theoretical and experimental study of the dynamic loads on airplanes." If such an award, for young men of promise, had been in existence twenty-five years ago, Lawrence Sperry himself could well have been the recipient. His achievement might have read "for flying fifty miles on a black night, from Moriches to Amityville, Long Island, the first night flight made in the United States."

Like Mr. Bergen, Lawrence was a flight test engineer. In those pioneer days, trial-and-error flights were the surest means he had of improving his design. For instance, Lawrence tested the first gyro turn indicator by diving into a cloud and measuring results by the angle at which he came out. His experiments on the first gyro pilot were made by walking out on the wing of an early Curtiss amphibian while flying over Hammondsport. When he tested the first aerial torpedo, he had to go along as a passenger to bring it back for the next test. It was the only model they had. As a matter of fact, the only time he didn't go along, that original model was never heard from again, although search for it went on around Long Island for many days.

The many young men who have lived and worked since then have brought aviation forward by leaps and bounds, and it remains a young man's field. There is probably no other industry in the country where a man of twenty-eight could hold a position equal in importance to Mr. Bergen's in The Glenn L. Martin Company. In six years he has come up from the ranks of the engineering department to Chief Flight Test Engineer, with, at the same time, full responsibility for the Vibrations Laboratory. It is Mr. Bergen and men like him who have given American planes the superiority of design which is playing such a vital part in winning this war.

Acceptance by Mr. Bergen

MR. WILLIAM B. BERGEN: It is being realized more every day that the airplane is essentially an elastic structure, subject to the laws of dynamics, and must be considered as such by the engineer, whether he calls it shake and shudder or just bump and flutter. Most of the problems are still ahead of us and much still remains to be done in the way of developing new instruments and new techniques. If this award will serve to stimulate added interest in this field, I feel that our efforts have been justified.

PRESIDENT DRYDEN: This year we inaugurate a new award in memory of Colonel Thurman H. Bane who was in command of McCook Field, the predecessor of Wright Field, the present

Edward G. Sperry (*left*) presents The Lawrence Sperry Award for 1943 to William B. Bergen.

NOW THOMPSON QUALITY IN ALL N.A.S. BOLTS!

For aircraft manufacturers requiring them, Thompson is now able to turn its facilities to the quantity production of internal wrenching head National Aircraft Standard Bolts, in a complete range of sizes and types.

THE same exclusive Thompson methods used in production of ultra-high quality, more expensive special bolts will be used in manufacturing the N.A.S. types. These methods are producing precision, high-strength bolts that are unmatched by *anything similar* in the field . . . that are used for vital jobs on aircraft where *no other bolt* can meet the stress demands.

These Thompson Methods of manufacture are included in all N.A.S. bolts produced

HOT FORGING—Thompson Bolts are hot-gathered in special electrical upsetting machines and forged to shape at red heat to produce the desired grain flow in the metal that increases strength and uniformity.

CONTROLLED HEAT TREAT—All Bolts are individually heat treated to produce a tensile strength ranging from 160,000 to 180,000 p.s.i.

GROUND SHANK—To produce a smooth gripping surface, free of tool marks and stress concentration points—and to remove decarburization—all bolts are ground to correct diameters.

GROUND THREADS—Thompson Bolts have ground threads—not rolled or cut—to insure a smooth, precision thread finish and to produce a perfect radius for maximum strength.

GROUND UNDER HEAD—Bolts are ground on the radius and under the head to insure 100% bearing surface and prevent stress concentration at any one point.

100% INSPECTION—Every bolt—not just a few from each run—is given an exhaustive series of inspections and checks to guarantee perfection in every bolt that leaves the plant.

These—and many other important steps in manufacture—are the *plus values* that go into all Thompson N.A.S. Bolts to insure the finest products in their class. More details on Thompson methods are yours for the asking.

With years of experience in producing bolts to the most exacting standards ever established, and with exclusive and better manufacturing methods now available, Thompson is ready to meet your N.A.S. bolt requirements. Write—today—outlining your particular bolt needs. Thompson Products, Inc., WEST COAST PLANT, Bell, Calif.

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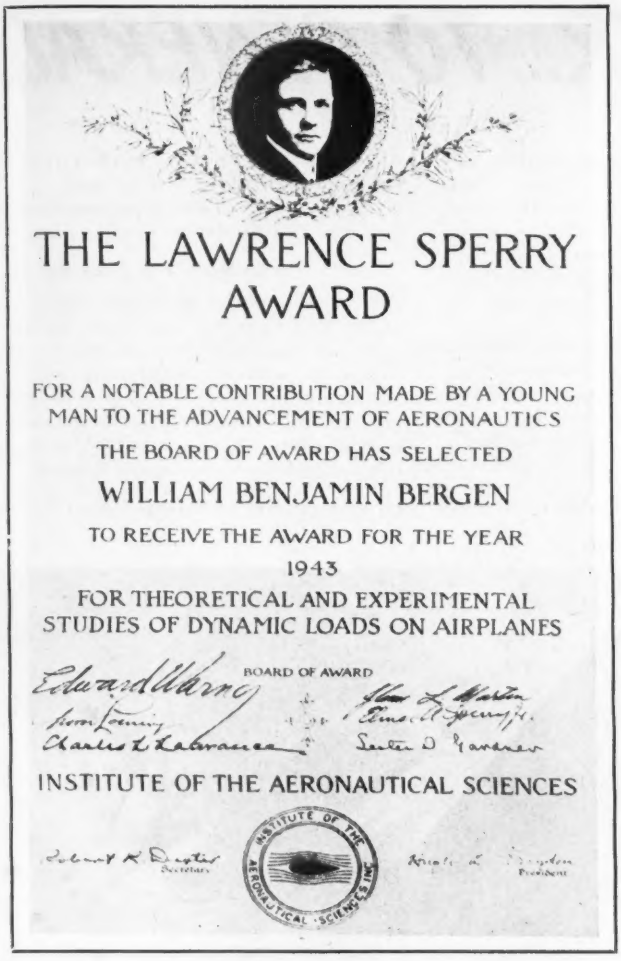
THE LAWRENCE SPERRY AWARD
FOR A NOTABLE CONTRIBUTION MADE BY A YOUNG MAN TO THE ADVANCEMENT OF AERONAUTICS
THE BOARD OF AWARD HAS SELECTED
WILLIAM BENJAMIN BERGEN
TO RECEIVE THE AWARD FOR THE YEAR
1943
FOR THEORETICAL AND EXPERIMENTAL STUDIES OF DYNAMIC LOADS ON AIRPLANES
BOARD OF AWARD
INSTITUTE OF THE AERONAUTICAL SCIENCES

home of air forces engineering work. Major Fleet is providing funds for the honorarium that goes with the certificate.

As the award this year goes to an officer for his outstanding technical contributions to helicopter development, we have asked Igor Sikorsky, a Fellow of the Institute, to make the presentation.

Presentation of The Thurman H. Bane Award

This award, to be presented for the first time at this Honors Night Dinner, honors the memory of Colonel Thurman H. Bane, one of the most prominent technical officers of the United States Army Air Corps, who died in 1932. It has been endowed by Major R. H. Fleet and provides an annual certificate of citation and honorarium of two hundred dollars to the recipient selected by the Board of Award.

MR. IGOR I. SIKORSKY: This award in honor of Colonel Thurman H. Bane is given to a member of the Army Air Forces Matériel Command for outstanding technical achievement.

Colonel Gregory, who was selected this year, merits this recognition because of his outstanding contribution to the development of the helicopter in the United States. I have had the good fortune of working with Colonel Gregory and, therefore, I had the opportunity of recognizing and admiring his knowledge, resourcefulness and ability. His assistance, encouragement and engineering advice have greatly helped our own and other organizations to make progress in this new, difficult and unexplored field of aeronautical engineering. Our own beginning in the field of military helicopters was undoubtedly accelerated to a great degree by the encouragement and advice obtained from Colonel Gregory. He actively participated in the flights of the new type of aircraft and willingly assumed the responsibilities and hazards that are inevitable when a so completely novel type of craft is being flight tested.

Among the outstanding flights of Colonel Gregory, I may mention that he piloted one of our craft to the greatest altitude reached by any helicopter in the world. He also established, unofficially, a number of other world records. He carried the first helicopter air mail in Washington in May, 1943, and it is interesting to note that it happened to be a day when the visibility was so low that all other aircraft had been grounded. Many of the airport personnel were very much surprised when they saw Colonel Gregory taking out the craft because it was not flying weather. Nevertheless Colonel Gregory took off and employed a very interesting kind of navigation by piloting the helicopter along the Potomac River and then along certain streets with which he was familiar until through the fog he could see the Capitol where the helicopter was to land.

In conclusion I want to state that Colonel Gregory's keen interest, untiring efforts, courage and faith, as well as his engineering knowledge, have greatly contributed to the development of the helicopter in the United States.

Acceptance by Colonel Gregory

COLONEL H. F. GREGORY: The Thurman H. Bane Award, to those of us who knew and respected the late Colonel Bane as one of the foremost prognosticators of vertical flight, as a daring pilot and as a capable engineer, means more than distinguished recognition. It is an award in whose name there was born a great spirit of progress and stick-to-it-iveness, for Thurman Bane was one of the first Army officers to take a serious interest in the helicopter and its many uses. His foresight and backing led to the Army's first helicopter, the De Bothezat machine of 1922–1923. It was no great success but it was a noble beginning that spurred greater interest in later years.

Colonel Bane, as Chief of the Engineering Division of the Air Service at McCook Field, Dayton, Ohio, which was a forerunner of the vast enterprise and research institution that today is the Matériel Command of the world's largest air force, fought for the experiments with the helicopter as no man in military circles had done before him. Colonel Bane himself worked very close with Professor De Bothezat in the development of the machine. He was first to fly the aircraft in December of 1922 and made many subsequent flights, though the wierd-looking craft never got very high into the air and lacked stability and control.

Almost eighteen years later, I was to be the Army's coworker with Dr. Sikorsky on the XR-4 and the succeeding models which are the world's first truly practical helicopters. Thanks to the marvelous testing and work done by Dr. Sikorsky and his able associates, the job in my time was far easier. He and I know of some of the trials necessary to bring out the present-day developments. There were many problems, many discouragements.

"TAIL GUNNER... TO GENERAL..."

What! Does the general *listen* to the tail gunner? In deed, if not in actual fact. Thus, a thousand tail gunners in a one thousand plane raid can see and report vital information to a thousand pilots . . . who in turn report via radio to their squadron commander . . . to group commanders . . . to generals . . .

• *But only because their radios are shielded from high tension engine ignition interference.* How? By the TITEFLEX RADIO SHIELDED IGNITION HARNESS on each engine—which thus helps keep clear the lines of radio communication from base to bombed-out Berlin.

• By actual performance under the worst conditions known to man, Titeflex ignition harnesses and flexible tubing have established themselves *as standard equipment on the majority of America's wartime airplanes.*

And Now . . . Aerocon

—a new, improved ignition conduit which by actual flight test provides even greater resistance to vibration — even greater electrical shielding protection. Already approved by the Army and Navy, already accepted by engine manufacturers. Data on AEROCON ignition conduit will be supplied to engine designers and engineers upon request

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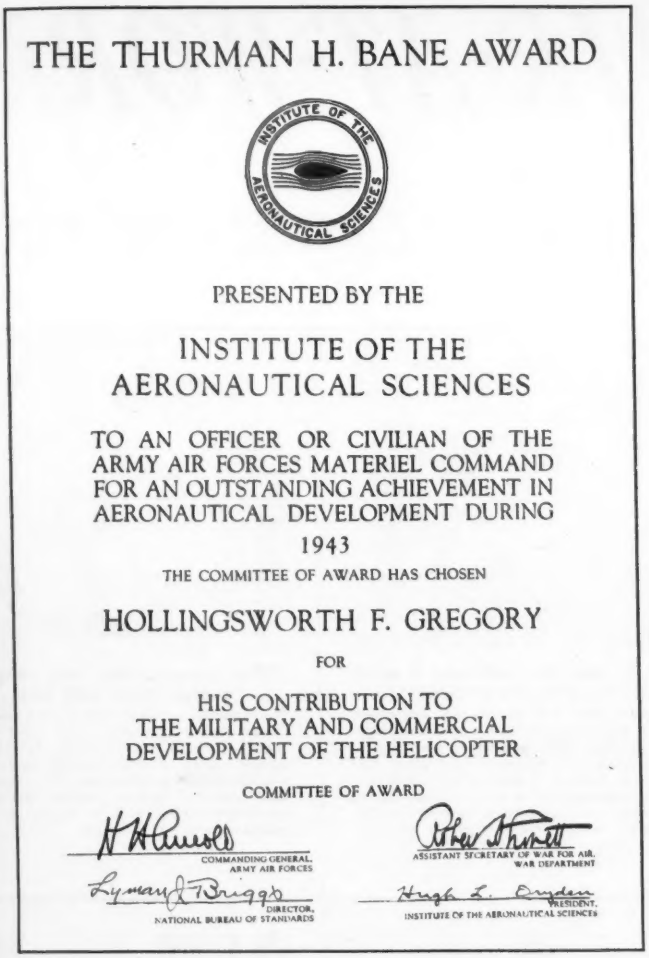


THE THURMAN H. BANE AWARD

PRESENTED BY THE

INSTITUTE OF THE AERONAUTICAL SCIENCES

TO AN OFFICER OR CIVILIAN OF THE ARMY AIR FORCES MATERIEL COMMAND FOR AN OUTSTANDING ACHIEVEMENT IN AERONAUTICAL DEVELOPMENT DURING 1943

THE COMMITTEE OF AWARD HAS CHOSEN

HOLLINGSWORTH F. GREGORY

FOR

HIS CONTRIBUTION TO THE MILITARY AND COMMERCIAL DEVELOPMENT OF THE HELICOPTER

COMMITTEE OF AWARD

COMMANDING GENERAL, ARMY AIR FORCES

ASSISTANT SECRETARY OF WAR FOR AIR, WAR DEPARTMENT

DIRECTOR, NATIONAL BUREAU OF STANDARDS

PRESIDENT, INSTITUTE OF THE AERONAUTICAL SCIENCES

During the early stages of the XR-4 and the VS-300 before that, there were times when the whole project seemed doomed to failure, not because of the craft itself, but because it was hard to build up faith in a machine for vertical flight. Man had tried so many times and failed. The helicopter in the future, when many problems now existing have been solved—and solve them we shall—will bring our new age of flight within reach of practically every-one.

It is an individual machine rather than a common carrier. Yet no one individual can take too much credit for the present successes that we have been able to obtain. Dr. Sikorsky perhaps is outstanding, but there have been many others who have contributed to the progressive development of this type of aircraft. What they have done is destined to bring to the world a new machine that will influence our everyday lives. It is a new age of flight that lies just ahead and in it the helicopter will play a major role.

Gifts to the Institute—1943

PRESIDENT DRYDEN: Before I ask Major Gardner to make his announcements, I wish to say a few words about an honor that came to the Institute through him during the year. Probably no one has ever arranged the honoring of others more than he. As President of the Aeronautical Chamber of Commerce and for many years before that, he organized the great dinners to distinguished pilots and visitors. He originated the idea of our Honors Night and had much to do with setting up these awards. Therefore, it was with great pleasure that the officers and members of the Institute learned that he was to be given an honorary degree by the Polytechnic Institute of Brooklyn last year. We have asked President Rogers to tell us about it.

DR. H. ROGERS: It is a unique privilege indeed to have the opportunity to read to you the citation which we made at the time that we honored ourselves by extending the honorary degree of Doctor of Laws to Major Gardner. Every great professional body has a number of particular attributes. One of these is a common interest in practical pursuits. Another is a body of knowledge, a heritage of the past and a development for the future. The third is a system of training and of education. The fourth is an organization whose object is to develop and promote the advancement of the science and the arts of the profession. A fifth is a system of recognition through membership, through medals, honors and fellowships, which you have seen in operation here this evening.

In selecting candidates deemed worthy of the honorary degree of the Polytechnic Institute of Brooklyn, we pride ourselves on the large percentage of our degrees that have gone to people who have received a degree from us for the first time. Your leader, Major Gardner, came to our attention because of the magnificent work that he has done in developing two of these great attributes of a great profession—your archives and your society. In granting the degree to him, we gave the citation as follows:

"Major Gardner, you have made great contributions to the profession of aeronautical engineering and to the aircraft industry. Your broad vision of the service which a professional institute, scientific publications and comprehensive archives can contribute to an expanding industry and to its underlying sciences, has inspired you through years of eminent achievement. The supporting institutions, which in other professions have required generations of growth, have flowered under your care and leadership within a few years. Your great energy and distinguished ability have contributed to the efficiency, the soundness and the greatness of these institutions. For your accomplishments you have been honored and esteemed by your fellow workers. For your helpfulness, your integrity and your high character, you are dearly and deeply beloved. In recognition of the honor of your achievements and in deep appreciation of your spirit of service, we honor ourselves in extending to you the degree of Doctor of Laws."

It was a great pleasure to us that we might have the privilege and the honor to be the first to extend a degree to Dr. Gardner.

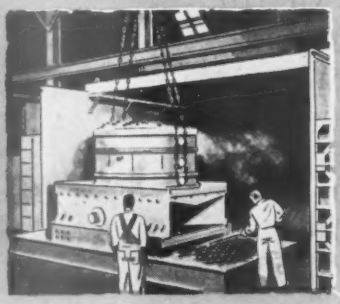
PRESIDENT DRYDEN: Lester, when your friends heard you were to be honored for your work in organizing and supervising the Institute, they wished you to know how much they, too, appreciated your long service. Several hundred wrote letters of encouragement to you and, tonight, I wish to present to you these two volumes containing the letters from your many friends. May they continue to inspire you and to give you the satisfaction that comes from praise from friends and admirers.

And now Dr. Louis Bauer, who was the first recipient of The John Jeffries Award, who is here representing the

Be sure "AIR-AT-WORK"

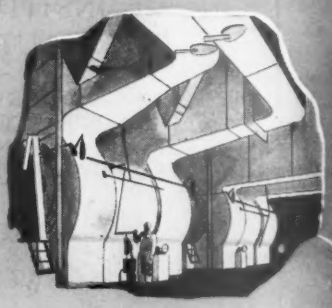
POST WAR PLANNING

A year ago it was unpatriotic to mention the word. Today it is industry's greatest challenge. A challenge that AIR-AT-WORK can help you meet—every step of the way—from designing a better product to making it more efficiently and improving the conditions under which it is made. Sturtevant Engineers have the knack of putting a finger on the *right* spots for air handling equipment. We invite an opportunity to sit down and discuss these applications in terms of *your* operations and products—without obligation.



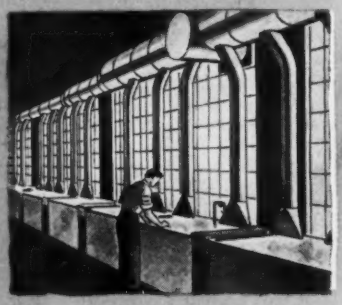
AIR to grab dust and keep it away from men and machines

Wherever dust will be created, Sturtevant has a special method of keeping it in line, safeguarding both employees and equipment, minimizing the cost of operation. For example, instead of carrying off and wasting heated room air, a new technique whirls it through dust separators, and returns the clean air to the room with all its valuable heat intact.



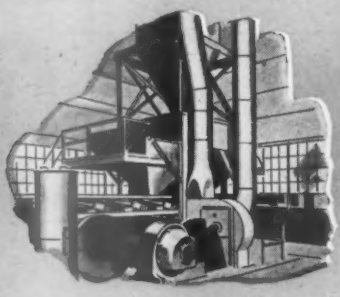
AIR to squeeze the last atom of energy out of your fuel

For tomorrow's power plant boilers, look to Sturtevant for the mechanical draft fans that will meet the demands for higher speeds, large volumes, highest pressures, temperatures and efficiencies. For example, new cyclone furnaces utilize Sturtevant centrifugal compressors to supply air for combustion at 70" pressure.



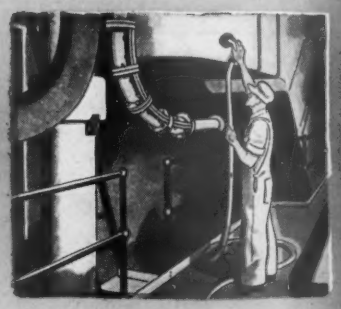
AIR to blast out fumes that keep you less than 100% efficient

If there's even a trace of fume or fog in your plant, look to Sturtevant for improved methods of holding it in check, adding years to the life-expectancy of both men and machines. For example, concentrations of acid fumes which formerly restricted production are now precision-controlled. Production line methods are possible without jeopardizing operators or equipment.



AIR to carry hard-to-handle materials with no waste motion

For handling any sort of loose material, Sturtevant has a pneumatic conveying system that picks it up and lays it down where it belongs without loss or labor. For example, an extra twist that Sturtevant gives one problem not only delivers light yet bulky materials throughout the plant, but thoroughly cleans them of dust and dirt en route.



AIR to spruce up your plant with a minimum of cost and labor

In meeting new standards of plant cleanliness, Sturtevant is headquarters for portable and central system Vacuum Cleaners that ferret out dirt faster, easier, more efficiently For example, improved methods of reaching into racks, bins and machinery, up to rafters, pipes and ledges, offer new opportunities to minimize health and production hazards, fire and explosion dangers and even to reclaim valuable dust.

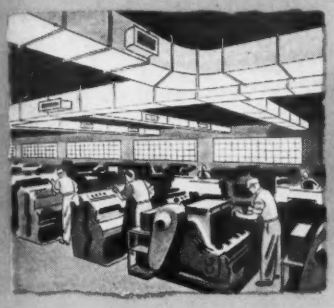
Sturtevant Equipment

REG U S PAT OFF

AND SYSTEMS

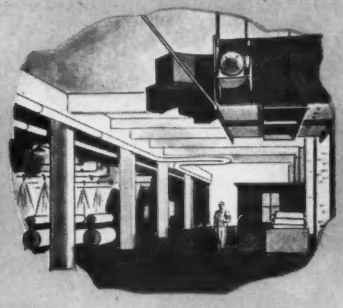
sits in on your

POST WAR PLANNING COMMITTEE!



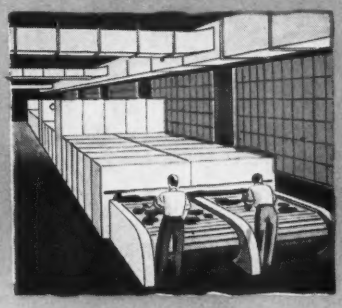
AIR to harness the weather to your production needs

For processes that must pay more attention to indoor weather, Sturtevant is ready with improved equipment and systems that permit matching the installation to the budget and process involved. For example, in the manufacture of ultra-precision instruments, air conditioning controlled within one degree of temperature and humidity makes possible assembly and test adjustments within tolerances of one millionth of an inch



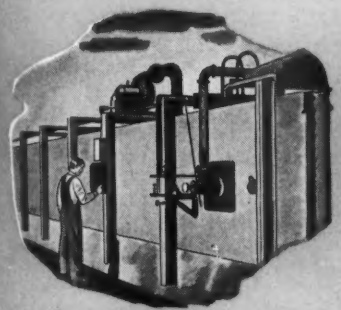
AIR to make every ounce of steam pay off in useful heat

In heating your plant tomorrow, count on Sturtevant for equipment and systems that put heat in the right places at the right temperature, cutting fuel bills in the bargain. Because Sturtevant manufactures all three types of unit heaters as well as central systems, we know what each can do best and which one or combination is best suited to your job.



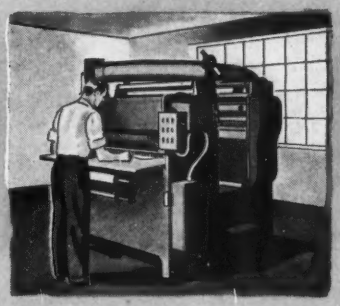
AIR to carry moisture out of your product more efficiently

In drying or dehydrating tomorrow's products, Sturtevant has developed new techniques for extracting moisture in a way that will increase output and improve product quality. For example, an ingenious arrangement of either tapered nozzles and baffle plates or perforated plates and plenum chamber now produces a change of heated air up to 300 times a minute near the material being dried.



AIR to boost up the pressure needed for special process work

When it's time to review production costs again, come to Sturtevant for suggestions and methods of utilizing a blast of high pressure air for closer control of combustion, cooling, drying, cleaning, agitation of liquids and countless other processes. For example, compressors now supplying a constant weight of air to foundry cupolas affect closer control of combustion, improved quality of castings.



AIR to help give your new products a jump on competition

Have you considered how air handling equipment, incorporated in your post-war product, can improve machine performance and product quality? For example, a blue print machine produces better prints faster with a specially designed and applied fan which exhausts heated air from the light chamber and uses it for drying prints more rapidly and uniformly

Why not discuss it with us *now*?

Sturtevant has long experience with ALL types of problems that *air at work* can solve . . . Sturtevant makes a wide range of equipment — and knows which can best lick any ONE problem. Add it up and you have the right place to bring your post-war problems. A Sturtevant Engineer is ready and waiting to discuss your particular needs—and to submit competent recommendations.

B. F. STURTEVANT COMPANY
HYDE PARK BOSTON 36, MASS.
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Engineered for Efficiency
IN HEATING, VENTILATING, AIR CONDITIONING, DRYING, DUST AND FUME CONTROL, PRESSURE BLOWING, VACUUM CLEANING, PNEUMATIC CONVEYING AND MECHANICAL DRAFT

Sturtevant
Puts Air to Work

When we say "spring"...

WE MEAN

Tight—a nut wrenched home sets up great pressure on threads and between all parts.

Aero Medical Association, has a message for you.

DR. LOUIS BAUER: The Aero Medical Association was organized before the Institute and as we were primarily interested in the medical aspects of aviation, we were naturally delighted to see the growth of an institution which was interested equally in all phases. The Institute has long devoted one section of its annual meeting to aviation medicine, and tonight is the fourth time the Institute has presented The John Jeffries Award. The President of the Aero Medical Association is on the committee which selects the recipients of that award. Both the Institute and the Association have high regard for each other.

About a year and a half ago the Aero Medical Association revised its constitution and by-laws and stole a leaf from the Institute's book by reclassifying our membership much along the same lines as the Institute. It was also provided that the Executive Council could elect honorary members for such period as it deemed advisable. The first one to be elected under the new by-laws is Major Gardner, who was elected at the last meeting of the Association in October, 1943.

Major Gardner's interest in fostering good relations between the two organizations, his efforts in promoting progress in aviation medicine and, above all, his outstanding efforts in promoting the development of all phases of aeronautics, make him the proper one to be so recognized. It is, I think, noteworthy that the council did not elect Major Gardner for a year or for five years, but for life.

PRESIDENT DRYDEN: Dr. Bauer, we thank you and the Aero Medical Society for the evidence of cooperation of our two societies. May this happy relationship ever continue.

MAJOR LESTER D. GARDNER: Those of you who know me will understand how pleased I have been to receive these honors that have come to me as the result of my association with the Institute. How little we thought in the early days that the aeronautical profession would some day reach a point where its members would be given honorary degrees for their work.

The latest honor from the Aero Medical Society again emphasizes the interest the Institute has taken in aviation medicine.

I believe that the Institute is unique in expressing its appreciation to donors publicly at its Honors Night Dinner. We give honors for outstanding technical advances. I know that you will agree that we should honor those who are making the Institute one of the most heavily endowed societies in the world. I hope that this part of the program will never be omitted, whether I am here to give it or not. It will always be an added incentive to those in charge of the affairs of the Institute to continue to seek new endowments and gifts.

Col. H. F. Gregory (*right*) receives The Thurman H. Bane Award for 1943 from Igor I. Sikorsky.

Of course, the greatest donor we have is Glenn L. Martin. The fund to honor his mother, Mrs. Minta Martin, which he is creating by yearly gifts, was valued on September 30 at $205,000, and the income from the securities in the fund amounted to $18,000 last year. This income is not for the upkeep of the Institute but for special purposes. Last Thursday he gave us 5,000 more shares of his company's stock which is valued at $85,000, which makes the total endowment today nearly $300,000.

It is a princely endowment for any son to give as an honor to his mother.

The generosity of the Guggenheim family to aviation was shown again last year. The Institute received a gift of $10,000 from the Daniel and Florence Guggenheim Foundation to be used in any way the Institute deemed beneficial. A gift such as this which is given without restriction is the kind that is of the greatest assistance to the Institute. It permits the use of the principal as well as the income. Our appreciation of the gift of Mrs. Guggenheim of the great estate of Daniel Guggenheim at Port Washington, Long Island, cannot be mentioned too often. The Institute is indeed fortunate in having such good friends as Mrs. Guggenheim and her son, Harry, who has for many years taken such an active interest in the stInitute's affairs.

It seems that no announcement I ever make does not mention another great friend of the Institute. Paul Kollsman last year added $6,250 to the endowment of the lending library. He gave, in memory of his brother, Otto, an additional gift of $2,000, which permitted us to purchase a collection of rare books which happened to be available. The income from the endowment was not sufficient to maintain the library, so the Square D Company of Detroit made up the difference with a gift of $5,000. That makes a total of over $92,000 which we have received from these good friends.

The Sperry family continue to add to The Lawrence Sperry Fund by sending a $1,000 bond every year.

I thought we had received from Mrs. Bella C. Landauer every aeronautical collection she had gathered for the past twenty years. But she didn't stop there. She continues to explore every shop that has any aeronautical relic or print. Almost every week last year we received a new addition to the great collection she gave to the Institute.

Last year we needed an automobile to carry friends and packages to Guggenheim Park at Port Washington, and I asked several friends if they knew anyone who might present us with a station wagon. Charles Colvin said he had one and he gave it to us. It was Mr. Colvin who interested Paul Kollsman in endowing the lending library.

In the early days of the Institute when we were poor, struggling to get organized and I had to make a touch, all that I had to do was to see Sherman Fairchild. After numerous small gifts, he gave us $25,000 and then added to that a valuable collection of rugs and furnishings and tapestries appraised at over $25,000.

I cannot mention here the hundreds of other gifts that have been made to the Institute. They are acknowledged in the REVIEW every month. The idea of having an aeronautical archives is bringing astonishing returns. It is a place where old friends, like Leo Stevens, are placing all their early papers. He has been active in aeronautics for fifty-one years. He is the man with the longest experience in aeronautics in the United States.

I look forward to next year with the highest hopes and the greatest confidence. May our dreams come true.

Betamizer MKIII MDII.

The Multi-Bellied Beta

Dr. J. C. Hunsaker, Chairman of the National Advisory Committee for Aeronautics; Mr. Charles L. Lawrance, President of the Lawrance Aeronautical Corporation; and Captain Luis de Florez (U.S.N.) gave a humorous demonstration of the development of the Multi-Bellied Beta, a Greek character written like the rounded letter B. This new symbol, the opposite of the familiar O.K., was proposed for use by aeronautical and other engineers when concluding exhausting mathematical analyses or when expressing their comments on new ideas or developments of no apparent value. They showed by a mechanical device its oral representation and demonstrated that it had many shades and tones of variation to express varying degrees of negation.

Induction of R. H. Fleet as President

PRESIDENT DRYDEN: The time has arrived for me to introduce my successor as President of the Institute. It has been a pleasant and interesting year of service. I wish to thank my fellow officers, council, membership and the staff, for the fine cooperation I have received. They have carried the real burdens and all honor should be given them for the accomplishments of the year.

Now I turn the direction of the Institute over to one of the best known men in aeronautics in the world. He is a great organizer, an air transport pathfinder, a director of notable engineering achievements, a successful industrialist, a man whose genius is recognized by the armed services and Government and the world of commerce, and an ever genial host. It is my pleasure to turn over to Major Fleet the presidency of the Institute.

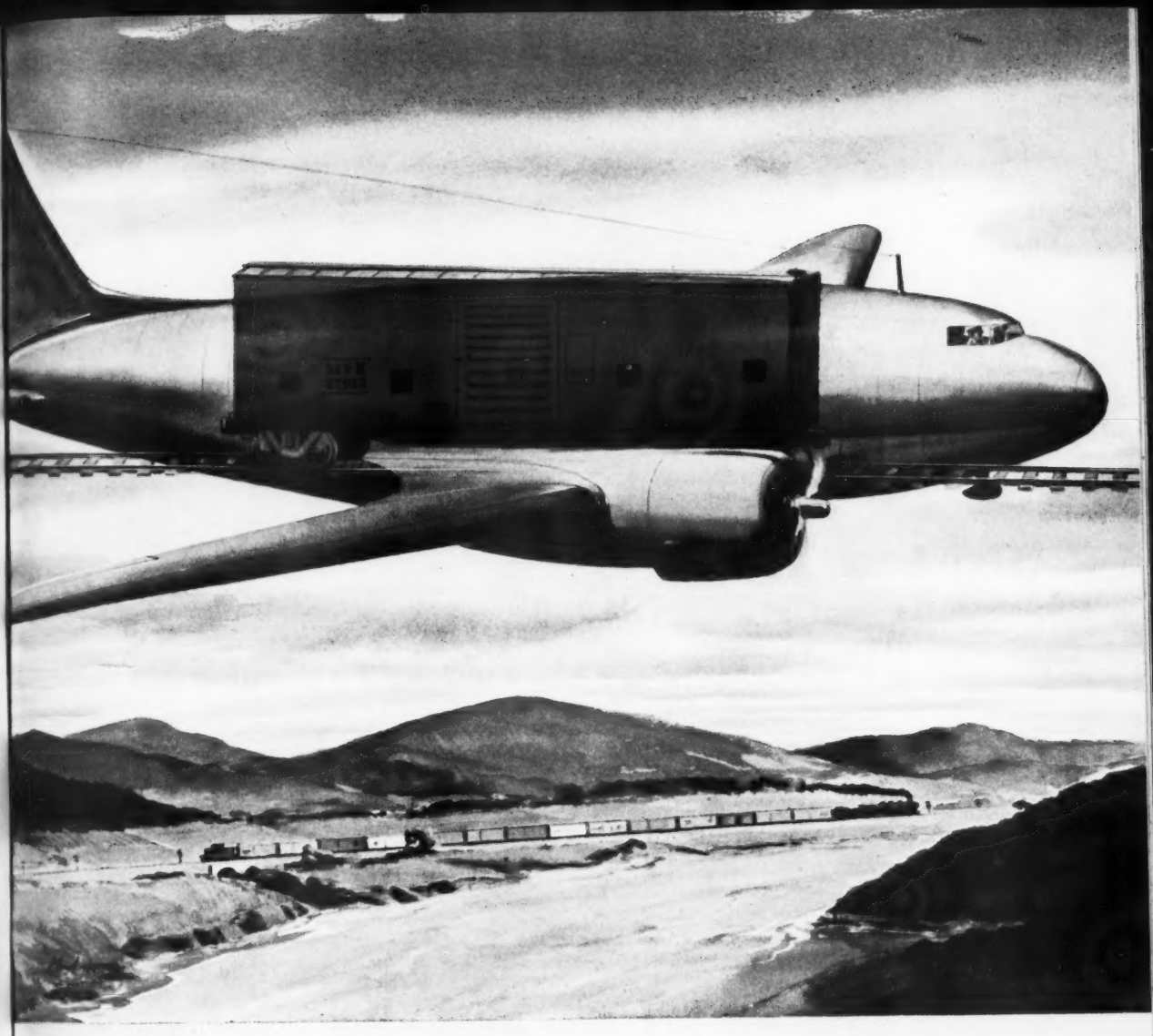
PRESIDENT R. H. FLEET: I am deeply conscious of the honor of being chosen to serve as President of the Institute of the Aeronautical Sciences. When I scan the list of my predecessors, I feel doubly honored, as it is they who have helped the founders guide the Institute to its present remarkable position. Its professional reputation is high. Its membership represents the leaders in the aeronautical sciences. Its financial position is astonishingly good. I hope to assist in directing the course of the Institute to still greater service to the aeronautical profession.

As you may know, I am not an aeronautical engineer, but there are few who have had closer contact with them. I have learned to have confidence in their foresight, judgment and ability, and have backed them in undertakings almost unreservedly. They must have everything double-checked, tested and proved, which is as it should be in aircraft design. Nothing exceeds a person's confidence in leaving mother earth and trusting his life to an airplane, unless it would be his distrust if he were betrayed in the strength and safety of the craft. Confidence is an attribute which honest men owe each other, and in an organization like this Institute, we learn to trust our members and friends with full confidence in one another's judgment. Many have shown their belief that this Institute is worthy of trust in the administration of large funds to help keep America supreme in the air, and I hope that our conduct of the Institute's affairs will continue to merit such substantial approval.

The aircraft industry is facing its most critical period. Its engineers have given the world the most advanced designs ever known. After this era of huge production will come the real age of flight, when in peaceful air commerce all over the world, peoples will have the opportunity of seeing one another oftener and of learning to know one another better than in the past, thus establishing good will among men.

I hope that through possession of preponderant air power our country will join others in insuring world peace against future aggression, and I hope that the aircraft engineering organizations which have done so much to preserve our way of life will be kept intact and at work advancing the art of aviation until it becomes the safest, cheapest and fastest means of transportation mankind ever will know for himself and his most precious goods. I hope that next year when we meet we shall celebrate victory.

R. H. Fleet, President.



Today's military flying freight car available for tomorrow's air commerce

The world's endless horizons are the only limits of tomorrow's air commerce. Curtiss Commandos —will ply peace-time skies making possible new standards of living for the people of the world.

Now being service-tested in the most rigorous of military duty, they are daily hauling men and supplies to our far-flung battle fields. A 3½ ton tractor . . . a gasoline tank-truck . . . two cumbersome dynamos . . . odd jobs and heavy ones but Commandos got them there on time.

Their 2755 cubic foot cargo capacity exceeds that of a 36 foot freight car. They *are* freight cars of the air. They can lug a useful load of 9 tons at cruising speeds in excess of 200 MPH.

The spacious cargo compartments of the Commando will bring the commerce of the world to your doorstep. When peace comes—LOOK TO THE SKIES, AMERICA! Curtiss-Wright Corporation, Airplane Division, Buffalo, N. Y.; St. Louis, Missouri; Columbus, Ohio; Louisville, Ky.

MEMBER, AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC.

2,000,000 — All-Americans

Today, not eleven men but more than two million make up the greatest All-American team in history. They are the flyers and ground crews of the U. S. Army Air Forces—and instead of a gold football on their watch chains, they wear the Army Air Forces' winged insignia.

On every play to date, these boys have strafed gaping holes in the enemy lines allowing our ground forces to get through for immeasurable gains. Their passes over the Reichland are causing panic. The only "spinner" they think of is a Zero crashing in flames.

Bell Aircraft is proud of its three-way role in helping to equip this greatest of All-American teams. Our Niagara Frontier Division has produced thousands of Bell Airacobras that have wrought havoc with the enemy on many fronts. Today, this division is also building a new type of fighter plane with even greater performance and before long, it *too* will be in the scrimmage.

Our Ordnance Division in Burlington, Vt., is working night and day building the flexible gun mounts which give the boys in the turrets the accuracy of fire-power that is knocking the enemy out of the skies at a terrific rate.

And soon, from the new Bell Bomber Plant in Georgia, will come more planes to help speed the day of victory.

Some day, soon we hope, this team will be returning to its home grounds. And when it does, it will find Bell Aircraft pioneering in building equipment for a peacetime nation on wings. © Bell Aircraft Corporation.

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL—EAST COAST, INC.

BELL AIRCRAFT

Niagara Frontier Division, Buffalo and Niagara Falls, N. Y.
Ordnance Division, Burlington, Vt.
Georgia Division, Marietta, Ga.

PACEMAKER OF AVIATION PROGRESS

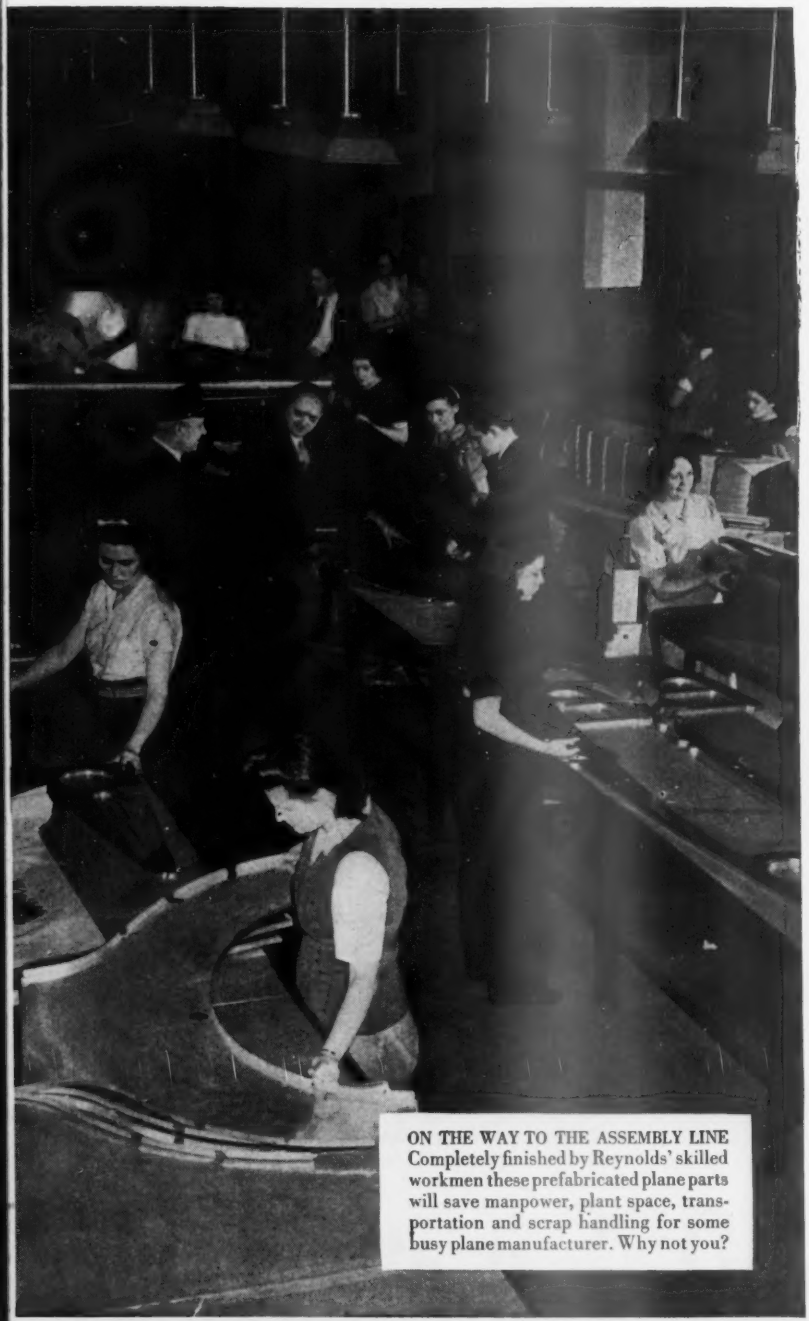
BUY WAR BONDS AND SPEED VICTORY

Your RED CROSS is at his side

Contribute today through your Local Chapter.

THIS SPACE CONTRIBUTED BY THE BG CORPORATION

Thousands of man-hours SAVED . . .



ON THE WAY TO THE ASSEMBLY LINE
Completely finished by Reynolds' skilled workmen these prefabricated plane parts will save manpower, plant space, transportation and scrap handling for some busy plane manufacturer. Why not you?

by Prefabricated Plane Parts Servic . . . Pioneered by REYNOLDS

Here's one answer to your manpower sho age. An answer that's already saving thousa of precious man-hours of airplane labor every leading manufacturer of combat plan

Under this plan, pioneered by Reyno only 3 years ago, completely finished pa come to your production lines ready for i mediate assembly. No longer is it necess to tie up valuable plant space with la stocks of aluminum sheet or die-cutting a forming machines.

Big savings in scrap handling realize

The Reynolds prefabricated plane parts se ice also does away with scrap handli Aluminum scrap, which averages 30% every sheet, is immediately re-rolled in prime sheet, then prefabricated into ne new parts, practically overnight.

It is this kind of progressive thinking a co-operative planning that has resulted in organization which now operates 40 plan in 14 states, and continues to grow by lea and bounds. For Reynolds men are not sat fied to have been the first to supply finish plane parts from aluminum sheet. They ha given themselves the continuous job of fin ing new ways to make aluminum better . easier and cheaper to use.

That's why you'll find Reynolds' resource equipment and engineering skill can be assistance in helping you with your alu num problems, *no matter what they may* Reynolds Metals Company, Aluminum a Parts Divisions, Louisville, Ky.

REYNOLDS METAL

REYNOLDS ALUMINUM

The Great New Source of

INGOT · SHEET · EXTRUSIONS · WIRE · ROD · BAR · FORGINGS · TUBING · TOOL · FOIL

Institute of the Aeronautical Sciences Twelfth Annual Meeting

THE TWELFTH ANNUAL MEETING of members of the Institute of the Aeronautical Sciences, Inc., was held in New York on the last Wednesday of January, as required by the Constitution and By-Laws, in the Pupin Physics Laboratories Building, Columbia University, at 5:00 p.m. on January 26, 1944. Dr. Hugh L. Dryden presided.

Ralph Upson, appointed by the President as Teller of Proxies, reported that he had received and counted 344 valid proxies for voting at the Annual Meeting—a quorum of the voting membership.

Dr. J. C. Hunsaker, on behalf of the Nominating Committee, placed in nomination the following members for election to vacancies on the council: Robb C. Oertel for a term of one year; Alfred Marchev for a term of two years; and Ralph S. Damon, Charles Froesch, R. Paul Harrington, and Earl D. Osborn for terms of three years each. On motion duly made, seconded and carried they were unanimously elected. The following were nominated and elected in like manner to serve on the Advisory Board for a term of one year: John D. Akerman, Walter Beech, Lawrence D. Bell, Don R. Berlin, Lyman J. Briggs, Jack Frye, P. G. Johnson, Th. von Kármán, J. H. Kindelberger, F. K. Kirsten, Paul Kollsman, Arnold M. Kuethe, William Littlewood, Thomas A. Morgan, W. A. Patterson, A. E. Raymond, F. W. Reichelderfer, J. T. Trippe, J. G. Vincent, Edward P. Warner, Raycroft Walsh.

Changes to the Constitution recommended by the Council, which were approved, are as follows:

ARTICLE II

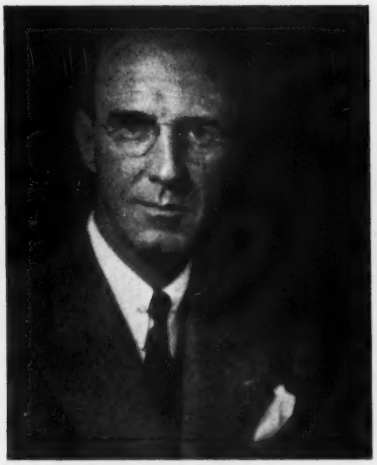
SECTION 1. Members of the Institute shall be elected to one of the following groups:

Honorary Fellows	Industrial Members
Honorary Members	Technical Members
Benefactors	Student Members
Fellows	Corporate Members
Associate Fellows	Affiliates

MEMBERS

ARTICLE III

SECTION 1. The Board of Directors, the governing body of the Institute, shall be known as the Council and shall consist of 12 members, elected by voting members of the Institute. The Council shall elect the President, the Chairman of the Council, the Assistant to the President, the Executive Vice President, four Vice Presidents, the Treasurer, Secretary and Controller of the Institute. The two immediate past Presidents of the Institute



Newly elected Council Members: (*top, left to right*) Ralph S. Damon, Charles Froesch, and R. Paul Harrington; (*bottom, left to right*) Alfred Marchev, Robb C. Oertel, and Earl D. Osborn.

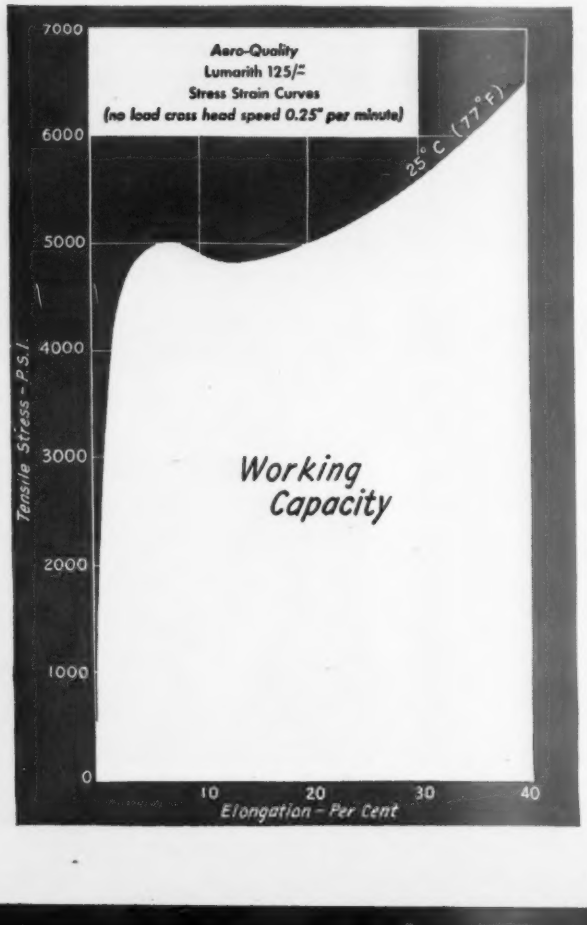
THE TOUGHNESS OF

Aero-Quality LUMARITH*

Gives Aircraft Designers a Chance to do things They Haven't Done Before

IMPACT STRENGTH

The impact strength of Lumarith is quite amazing. . . . Down around the minus sixties (Fahrenheit), it is about what designers are accustomed to expect from other plastics—that is 0.4 ft.-lbs. per inch of notch Charpy, on an ⅛" sheet at 50% R.H. But from there up, on the temperature range, the impact strength of Lumarith leaves other types of plastics for aircraft glazing far behind. . . . At 40° F., Lumarith impact strength passes 1.0 ft.-lbs. . . . At 150° F., it is greater than 4.0 ft.-lbs.



SELF-DISTRIBUTION OF LOCAL STRESSES

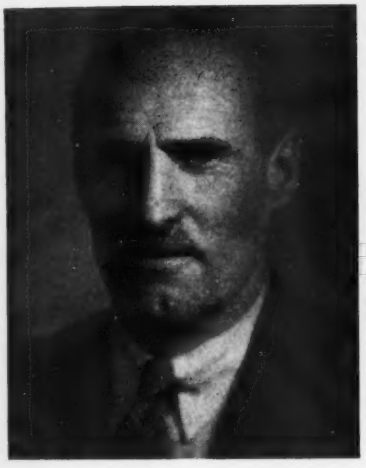
Another strong point in Lumarith's properties is its ability to relieve stress concentrations. With Lumarith, due to its "give," local stresses are readily transmitted to neighboring sections so that a more uniform stress distribution is obtained and local failure is less likely to occur.

WORKING CAPACITY

The areas under the Aero-Quality Lumarith stress-strain curve show its excellent resistance to breaking or cracking under deformation. The figures are: 42 ft.-lbs. per cubic inch at 32° F. . . . 170 ft.-lbs. per cubic inch at 77° F. . . . 195 ft.-lbs. per cubic inch at 95° F. Above 100° F., other accepted plastics match Lumarith in this phase of toughness. But at the usual operating temperatures, Lumarith rapidly steps into a class by itself.

If you haven't received a complete set of graphs on Aero-Quality Lumarith, send for them immediately to Celanese Celluloid Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16.

*Reg. U. S. Pat. Off.



Continuing to serve as Council Members are: (*top, left to right*) P. R. Bassett, W. A. M. Burden, and R. T. Goodwin; (*bottom, left to right*) C. S. Jones, Roger Wolfe Kahn, and John C. Leslie.

shall be members of the Council ex officio without vote.

ARTICLE IV

SECTION 2. The Council may make, amend or revoke such By-Laws as it deems necessary from time to time by a majority vote of its members at a regularly called meeting. The voting may be either by letter ballot, in person, or by proxy. It shall be required that the proposed changes and the reasons therefore be prepared in writing and mailed to all members of the Council at least five days prior to such meeting.

SECTION 3. The officers of the Institute shall perform the duties legally or customarily attaching to their respective offices under the laws of the State of New York, and such other duties as may be required of them by the Council and the By-Laws.

Charles Colvin placed in nomination the following Past-Presidents of the Institute to serve as the Nominating Committee for 1944: Frank W. Caldwell, Hugh L. Dryden, Charles L. Lawrance, George W. Lewis, and T. P. Wright. On motion duly made, seconded, and carried, they were elected.

The Annual Reports of the President, Treasurer, Administrative Committee, and President of the Aeronautical Archives were read and approved.

Awards and Officers

The Secretary presented a list of honors conferred by the Institute in 1943 as follows:

The Sylvanus Albert Reed Award to Dr. Sanford A. Moss.

The Octave Chanute Award to William H. McAvoy.

The Lawrence Sperry Award to William Benjamin Bergen.

The John Jeffries Award to Brig. Gen. Eugen G. Reinartz.

The Robert M. Losey Award to Lt. Col. Joseph J. George.

The Thurman H. Bane Award to Col. Hollingsworth F. Gregory.

Honorary Fellowship in the Institute to Gen. Henry H. Arnold, Commanding General, Army Air Forces; Sir Richard Fairey, Director General, British Air Commission.

Fellowship in the Institute to Wellwood E. Beall, Luis de Florez, Ivan H. Driggs, Jack Frye, Edward H. Heinemann, Boris V. Korvin-Kroukovsky, Eugene E. Lundquist, James M. Shoemaker, John Stack, and Jesse G. Vincent.

Honorary Membership in the Institute for the year 1943 was conferred by the Council upon Rear Adm. D. C. Ramsey, Chief of Bureau of Aeronautics, Navy Department.

A resolution was passed expressing the appreciation of the Institute to President Nicholas Murray Butler and Dean George B. Pegram of Columbia University, for the cooperation and gracious hospitality extended to the Institute.

The Secretary announced the officers of the Institute for 1944 elected by the Council at its meeting on December 28, 1943, as follows:

President	R. H. Fleet
Vice-Presidents	Wellwood E. Beall
	William K. Ebel
	Elmer A. Sperry, Jr.
	G. M. Williams

Save time and trouble by specifying G-E SYSTEMS---*packaged systems!*

ALL you have to do is tell us the performance required of your control system—we'll select all the relays, contactors, pressure and limit switches, and other control devices that are needed, and build them into a system specially designed for your purpose.

No system too complex

No matter what your control needs are—for control of motors, temperature, positioning, etc.—and no matter how intricate the system must be, we can furnish a packaged system to fill the bill. Our equipment is specially designed for lightness. Also, it's designed to withstand severe vibration and to operate at rated current at high altitudes.

These advantages, too:

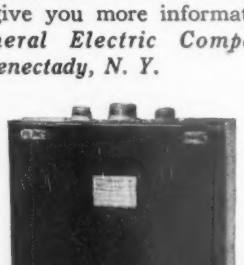
1. From design right through to test, the system is engineered by General Electric, relieving your engineers of a time-consuming and often difficult task. Careful circuit design by G-E engineers permits simplification without sacrificing performance. For example, it is often possible for us to make one device do the work of two, thereby keeping weight and space requirements low.

2. All the required control devices are assembled, wired, and tested as a unit at our factory, eliminating these operations in your plant, and enabling you to use your available man power and plant space for other purposes.

3. The entire system is assembled in lightweight aluminum enclosures and shipped to you ready for installation in the plane.

4. Centralized responsibility—which means that you can put your control problems up to us, and we'll furnish a system that will do exactly what you want.

Before you again order aircraft control, look into the possibilities and advantages of G-E packaged systems. Our local representative will be glad to give you more information. *General Electric Company, Schenectady, N. Y.*



Duplex, synchronizing d-c control. Typical of G-E systems for aircraft.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

PRECISION PRODUCTS AND ENGINEERED SYSTEMS FOR AIRCRAFT

Executive Vice-President	Bennett H. Horchler	Assistant to the President	George R. Forman
Treasurer	Charles H. Colvin	Secretary	Robert R. Dexter
Chairman of the Council	Lester D. Gardner	Controller	Joseph J. Maitan
			ROBERT R. DEXTER

The President's Annual Report, 1943

The Institute began its second decade of service to the aeronautical profession by a continuance of financial gains, expanded services, and an increase of confidence in its purposes. Your officers and Council, and committees as well, have rendered efficient and unselfish service. The staff of the Institute has creditably managed the affairs of the Institute under the direction of the Administrative Committee, which was organized last year.

To our generous friends who have placed the Institute in such an enviable financial position, we express our continuing appreciation. To Glenn L. Martin, Mrs. Daniel Guggenheim, Paul Kollsman and the Square D Company, Sherman Fairchild, Mrs. Bella C. Landauer, Charles Colvin, Major R. H. Fleet, the Sperry family, and hundreds of others who have made gifts and left bequests to the Institute and its Archives, we again express our appreciation.

Those who are charged with the management of the Institute cannot too often express appreciation to the many donors who have made gifts to the Institute. It is significant that these contributions have come from those who have been close to the management and operation of the Institute and have observed the cautious financial procedure of the Council and the Finance Committee.

The Administrative Committee's report shows that the Institute has made conservative gains in membership during the past year. If we had not adhered to our policy of avoiding solicitation of membership, we might have had an increase corresponding to the great expansion of the aeronautical industry, but your officers preferred to continue the present prudent course.

The Branches and Sections of the Institute have held many technical meetings during the year. The officers and committees that have supervised these meetings of the Branches and Sections deserve commendation for the zeal and time they have given to Institute activities.

The Daniel Guggenheim property, which was given to the Institute by Mrs. Guggenheim, is being maintained in good condition until some suitable use may be found for it. The limited use of automobiles, the man-power shortage, and the restrictions on building materials present problems that a committee is studying. There have been several offers from Government agencies to use the estate, but none has reached a point of occupancy. The Council believes that a conservative policy in making any plans regarding the estate is the proper course at this time.

The Archives and the libraries have continued to expand during the year, as will be seen from other reports. Generous donors are making gifts to the collections in increasing numbers. It is evident that the plan of having a place where persons know that valuable and interesting relics and mementos will be safeguarded and seen by visitors has brought to the Institute many valuable gifts.

The growth of activities of the Institute and particularly the expansion of the libraries present problems that can only be solved by the Institute eventually having a building of its own. This important need is receiving attention and, if a suitable location could be found, there is little doubt but that a new home for the great collections of the Institute could be secured.

The JOURNAL OF THE AERONAUTICAL SCIENCES has been changed to a quarterly as a paper and printing conservation measure and to provide members with a technical journal in which each issue covers a broader field. The number of papers printed will not be reduced but grouped in four issues instead of twelve.

The AERONAUTICAL ENGINEERING REVIEW has had a phenomenal growth that has been made possible by the present size of the aircraft industry and a desire to place announcements before the aeronautical engineering profession. As is the case of other societies, the income is being used to provide greater service to members, to maintain and enlarge the libraries and collections, and to create a reserve for postwar contingencies.

The AERONAUTICAL ENGINEERING CATALOG will be issued in 1944 and sent to all members of the Institute who request it. It will be an added service to members and will provide aeronautical engineers with a handy reference book of specifications such as is available in other scientific fields.

Although there has been a great increase in the assets of the Institute, as will be seen from the report of the Treasurer, there has been little change in the budget. By a conservative policy of investment it is gratifying to report that all funds entrusted to the Institute are worth more today than when they were given—a condition that is rare under present circumstances. The direction of the Pacific Aeronautical Library of the Institute has been taken over by the Aircraft War Production Council, West Coast, Inc., and has increased its services to members and companies on the West Coast.

I have appreciated the cooperation of the officers and the staff of the Institute during the past year. Their interest in its welfare and their regard for the high standards and purposes of its founders should be appreciated by the entire membership as it is by me. There has been a turnover of over 50 per cent in the personnel of the staff of the Institute because of the prevailing conditions, but in spite of this handicap its activities have progressed without any embarrassing interruptions.

We are grateful for the continued support and interest of the aircraft industry. The confidence shown by our Corporate Members, who have increased from 93 to 145 during the year, has enabled the Institute to function with a small excess of income over expenditure. But of even greater importance is the assurance it has given to donors that the work of an aeronautical scientific and engineering society is appreciated and that it is a safe organization to endow.

Almost every member of the Institute is engaged in some part of the war effort in which aircraft is taking such a dominant part.

HUGH L. DRYDEN

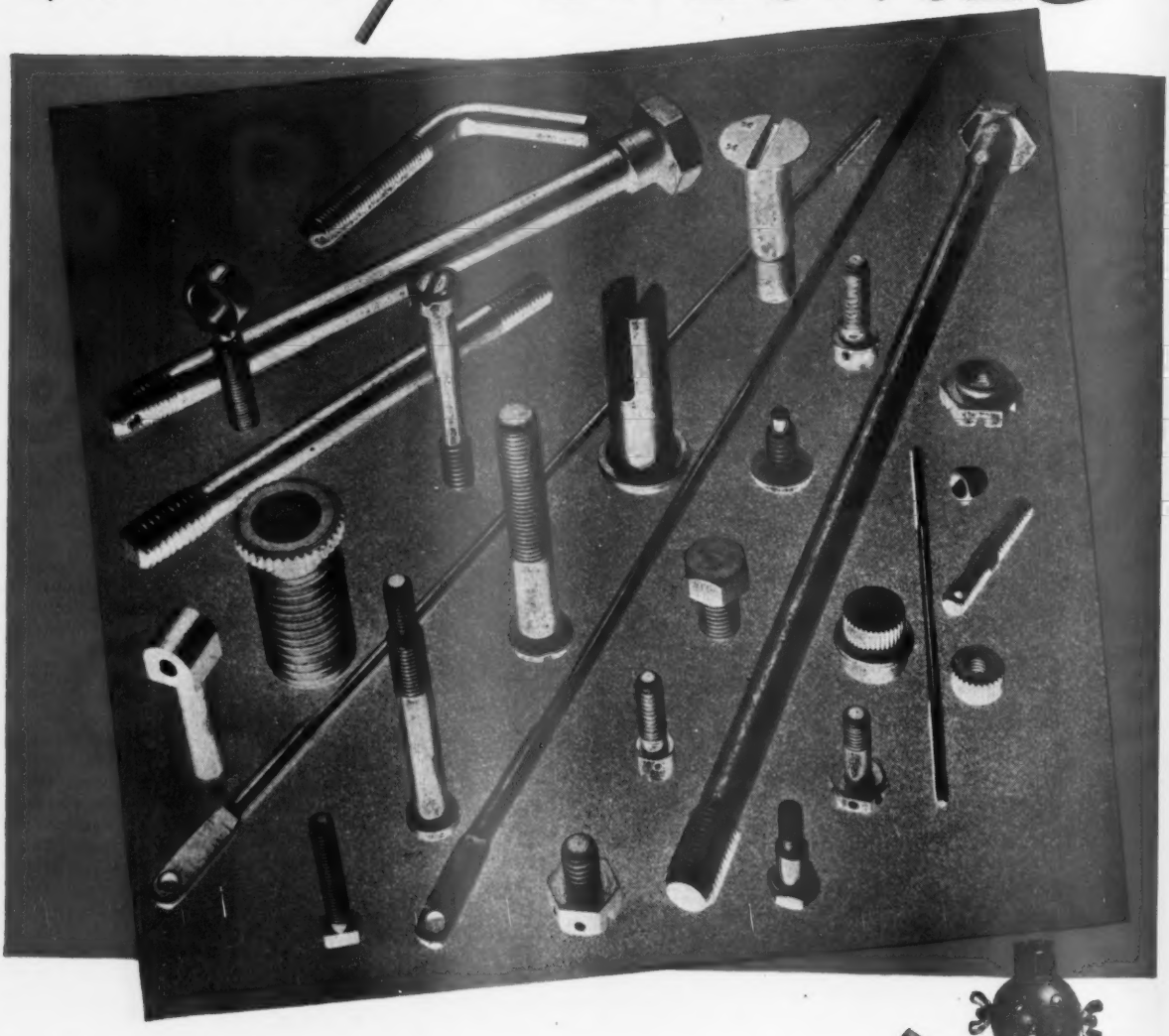
Treasurer's Annual Report—October 1, 1942, to September 30, 1943

The audited statement of the Institute shows an increase in assets from $768,264.32 last year to $943,982.30 this year or a net increase of $175,717.98.

The total unexpended income of the Institute is now $38,699.71, of which $14,272.49 was added this year, showing that the Institute is operating well under its income. Major R. H. Fleet, who in 1942 made a gift of $10,000 to the Institute, authorized the Council to add this amount to the Institute's unexpended income account.

Glenn L. Martin gave the Institute another 5,000 shares of stock of his company which was placed on the books at the market valuation of $100,625. Paul Kollsman purchased a collection of books for the Institute at a cost of $2,000. He also added to The Paul Kollsman Fund a $6,250 gift bringing this Fund up to $58,750. The Sperry family added another $1,000 to The Lawrence Sperry Award Fund to increase this Fund to $8,000. A contribution of $5,700 was received from the Daniel and Florence Guggenheim Foundation, and Charles H. Colvin gave the Institute his station wagon valued at $900.

Aircraft "SPECIALS"



NATIONAL SCREW HAS EXCEPTIONAL FACILITIES FOR PRODUCING SPECIAL AIRCRAFT FASTENERS

In addition to the regular AN and ANS standard fasteners, "National" aircraft products include many special parts designed by airplane and parts manufacturers.

A few of these "specials" are pictured above, such as carburetor studs, motor mounting bolts, swaged rods, drilled head bolts, stainless eyebolts, brake adjustment screws, carburetor screws, gyroscope struts, dome nuts, shear bolts, and a number of others.

"National's" engineering and metallurgical experience, modern manufacturing and heat-treating facilities, and closely integrated production layout—including our own wire mill—equip us to give our customers exceptional service.

National
HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

Statement for the fiscal year October 1, 1942, to September 30, 1943

Consolidated Balance Sheet

ASSETS

General Fund Assets:		
Cash on Deposit and Petty Cash		$ 16,206.27
Advances and Loans Receivable		16,100.00
Accounts Receivable		14,239.38
The Benefactor Membership Fund:		
U.S. Treasury Bonds	$ 32,000.00	
Cash on Deposit	956.95	32,956.95
Deposits and Advances		6,378.93
Furniture and Fixtures Inventory		5,000.00
Books, Prints, Models, Medals, etc.		1.00
Aeronautical Index		1.00
Total General Fund Assets		$ 90,883.53
Investment of Restricted Funds:		
The Sherman M. Fairchild Publication Fund:		
U.S. Treasury Bonds	$ 25,000.00	
Cash on Deposit	342.93	$ 25,342.93
The Paul Kollsman Fund:		
U.S. Treasury Bonds		65,000.00
The Vernon Lynch Award Fund:		
Stocks	$ 14,260.00	
Cash on Deposit	375.75	14,635.75
The Minta Martin Aeronautical Fund:		
U.S. Treasury Bonds & Stocks	197,387.84	
Cash on Deposit	16,101.28	213,489.12
Property Fund:		
Daniel Guggenheim Park—Assessed Valuation		514,450.00
The Sylvanus Albert Reed Award Fund:		
U.S. Treasury Bonds	$ 11,000.00	
Cash on Deposit	116.58	11,116.58
The Lawrence Sperry Award Fund:		
U.S. Treasury Bonds	$ 8,000.00	
Cash on Deposit	1,064.39	9,064.39
Total Restricted Fund Assets		$853,098.77
Total Assets*		$943,982.30
* Unrealized appreciation on investments		5,580.50
Grand Total Assets		$949,562.80

LIABILITIES, FUNDS AND UNEXPENDED INCOME

Liabilities:		
Accounts Payable	$ 4,766.05	
Deferred Dues Income	21,263.93	
Deferred Subscription Income	10,196.89	
Unexpended Income—Benefactor Member Fund	956.95	$ 37,183.82
Reserve for Post-War Contingencies		15,000.00
Unexpended Income:		
Balance October 1, 1942	$ 14,427.22	
Fleet Fund Transfer	10,000.00	
Unexpended Income for the Year Ended September 30, 1943	14,272.49	38,699.71
Total Liabilities and Unexpended Income		$ 90,883.53
Restricted Funds: (See Assets)		
Total Restricted Funds		853,098.77
Total Liabilities, Funds and Unexpended Income		$943,982.30

Statement of Income and Expenses

INCOME

Dues (less subscriptions)	$ 68,152.49	
Entrance Fees	3,345.00	
Excess of Income over Expenses: Aeronautical Engineering Review	5,848.51	
Total Income		$ 77,346.00

EXPENSES

Administrative, Clerical & Accounting	$ 26,123.23	
Award Expenses	1,086.44	
General Expense	15,197.81	
Depreciation & Furniture Write-Off	4,353.76	
Excess of Expenses over Income: Journal of the Aeronautical Sciences	1,312.27	
Total Expenses		$ 48,073.51
		$ 29,272.49
Less: Provision for Post-War Contingencies		15,000.00
Net Unexpended Income for the Year October 1, 1942, to September 30, 1943		$ 14,272.49

Detail of Journal and Archives Income and Expense

Journal

INCOME

Subscriptions	$ 20,769.55	
Reprints	128.40	
Total Income		$ 20,897.95

EXPENSES

Administrative, Editorial & Clerical	$ 11,061.61	
General Expenses	11,148.61	
Total Expenses		22,210.22
Excess of Expenses over Income—See Institute Expenses		$ (1,312.27)

Aeronautical Archives

INCOME

Advertising Revenue—Aeronautical Engineering Review	$147,577.54	
Subscription Revenue—Aeronautical Engineering Review	17,199.33	
Total Income		$164,776.87

EXPENSES

Aeronautical Archives & Libraries	$ 48,322.47	
Review Administration, Editorial & Accounting	36,577.25	
Review General Expense	74,028.64	
Total Expenses		158,928.36
Excess of Income over Expenses—See Institute Income		$ 5,848.51

The furniture and fixtures inventory has been depreciated to $5,000. The total cost of the office equipment exceeds $20,000.

The libraries, indexes, and collections are shown on the books at $1.00. Included in this valuation are the Works Projects Administration Indexes, which cost over $300,000, Sherman M. Fairchild's gift of antique furniture, rugs, and tapestries valued at over $25,000; Mrs. Bella C. Landauer's collections of Aeronautica Americana, and the hundreds of other gifts of aeronautical prints, medals, insignia, models, some so rare and valuable that no estimate can be made of their value. If these gifts and collections were appraised and included in the assets of the Institute, the assists would be several hundred thousand dollars more than shown on the balance sheet.

The Aeronautical Engineering Review showed an excess of income over expenses of $5,848.51. The publication was started from library funds in 1940 to supplement the services of the libraries and Archives. This year the income from the Review was such that it covered the costs of the Archives and libraries. The Journal of the Aeronautical Sciences cost $1,312.27 over the income from subscriptions.

This is the eighth of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.

"Our deadliest weapon can build world unity"

Says A. N. KEMP, President, American Airlines, Inc.

"THIS WAR *has given wings to millions of men who never before had an opportunity to fly. Most of them, unfortunately, have flown on missions of death, for the airplane has become our deadliest weapon in defense of human rights. But the airplane is also our means of* uniting *the world.*

"The airplane implemented our will to confer with our Allies at Teheran and Casablanca and Cairo. Throughout the world the airplane can make possible similar meetings among men on peaceful missions—businessmen, scientists, writers, statesmen, and ordinary citizens. For before many years new mechanical equipment will put air transportation within the economic grasp of the average person in all civilized countries. With statesmanlike planning and a will to co-operate, we can make air transportation the instrument of unity for the whole world."

THUS while war planes blacken the skies, does Mr. Kemp affirm the great peacetime promise of flying-to-come—a promise that cannot be fulfilled by the aviation industry alone, but demands the participation of a "test-pilot market"—a market of people who (in business or in private living) are habitually first to accept any change for the better.

This is the market aviation thinks of when it thinks of the more than a million TIME-reading families—people with the foresight, income, and influence that aviation needs to implement its programs—(people able to support with their patronage and prestige any business which executives now in aviation may enter after the war).

Believing that the ideas of aviation's leaders are always of interest to the aviation industry,
TIME here gives them wider circulation
in the name of

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

The care and prudence of the Council and Officers of the Institute in managing its financial affairs are represented by the gradual increase in its assets and unexpended income. Since it is realized that unforeseen problems may arise in the future, the Council has set aside out of current unexpended income a reserve of $15,000 for postwar contingencies. This reserve will be increased as conditions warrant. Your Treasurer would like to call the attention of the membership to the danger of overoptimism regarding the financial condition of the Institute. Although the Institute has large funds that are restricted, it does not have a sufficient reserve for postwar readjustment. It is recommended that the Council give careful consideration to this problem.

The books are examined by a firm of certified public accountants, and they state that the statements of income and expenses fairly present the results of the operation of the fiscal year ending September 30, 1943.

ELMER A. SPERRY, JR.

So that the financial statement for 1942–1943 may be compared with that of previous years and the increases noted, the following table of assets and unexpended income is presented:

Year	Total Assets	Unexpended Income by Year	Total Unexpended Income
1933	$ 1,176.92	$ 705.01	$ 705.01
1934	7,717.18	3,465.63	4,170.64
1935	6,338.22	462.48	4,633.12
1936	20,906.90	261.43	4,894.55
1937	23,497.66	408.14	5,302.69
1938	35,776.91	281.93	5,584.62
1939	46,149.64	918.37	6,502.99
1940	67,995.56	1,828.56	8,331.65
1941	101,583.40	2,495.64	10,827.29
1942	768,264.32	3,599.93	14,427.22
1943	943,982.30	14,272.49	38,699.71

Report of the Administrative Committee

Membership

At the end of its eleventh year, the Institute has passed the 5,800 mark in total membership The membership by grades as of January 1, 1944, is as follows:

Honorary Members	9
Honorary Fellows	15
Fellows	153
Associate Fellows	426
MEMBERS	1,091
Industrial Members	223
Technical Members	2,798
Total Graded Members	4,715
Affiliates	91
Student Members	1,034
Total Membership	5,840

During the calendar year, 1,327 new members were admitted in grades above those of Affiliate and Student Member. Of these, 519 were transferred from previous Student Membership to Technical Membership and 808 were admitted to this and higher grades of membership by application to the Admissions Committee.

The membership was decreased by the death of 24 members, resignations of 11, and 155 dropped from the list of enrolled members. In addition to some dropped for nonpayment of dues, this last figure includes a considerable number of former members whose present status and whereabouts are at present unknown. All who were in enemy or enemy-occupied territory are not included in present membership totals, since their status cannot be determined until after the war.

Subtracting these deletions from the total of new members leaves a net increase of 1,137 graded members for the year 1943. The enrollment of Student Members, who are admitted and renewed on a yearly basis, was lower by 546 Student Members on January 1, 1944, than the enrollment of 12 months previous. Fifty-eight Affiliate members were admitted during the year. Thus, there was a net increase in enrollment of 649 members in all grades since January 1, 1943.

Meetings

In addition to the many local meetings held by the various Sections, the Institute has sponsored the following National Meetings: the Eleventh Annual Meeting held simultaneously in New York, Detroit, and Los Angeles; the Air Transport Meeting held in Washington, D.C., in October; and the Seventh Wright Brothers Lecture, also held in Washington, in December.

An expanded program of specialized National Meetings was started during the year with the Air Transport Meeting in Washington. Following the Technical Sessions of the Twelfth Annual Meeting, a Light Aircraft Meeting will be held in Detroit in April. A Design and Postwar Planning Meeting will be held in Los Angeles in July, to be followed by an Air Transport Meeting in October and the Eighth Wright Brothers Lecture in December.

Active Sections of the Institute are in Akron, Buffalo, Detroit, Los Angeles, San Diego, and Seattle. The Buffalo Section of the Institute was organized during the year and new Sections are in the process of organization in Baltimore and Cleveland.

Student Branches

Because of the pressure of war conditions, the Student Membership of the Institute has decreased, but the various Student Branches of the Institute have been as active as present conditions permit. There are at present Branches of the Institute in 39 schools and colleges. During the year, a total of 112 meetings was reported to the Institute by Branch secretaries.

Publications of the Institute

In March, 1943, the War Production Board limited the amount of paper available to the Institute for printing the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW. In order to comply with the limitation order, the weight of paper used in the magazines and the trim sizes of both magazines were reduced. The publications of the Institute are now printed on the lightest weight stock practicable for use by the printer of both magazines.

As the growth in the membership of the Institute necessitated additional conservation measures, commencing in July no additional advertising was accepted for the AERONAUTICAL ENGINEERING REVIEW, and the JOURNAL OF THE AERONAUTICAL SCIENCES changed its frequency of issue from a monthly to a quarterly. This change was accomplished without penalizing members, as the quarterly issues were so planned as to contain three times the amount of text normally printed in the monthly issues. However, the effect of this change of frequency in the JOURNAL resulted in saving the printing of eight sets of covers and eight sets of seven standing pages during each year—an appreciable quantity of paper.

To further cut down the use of paper and to anticipate required service for incoming new members of the Institute, complimentary subscriptions to both publications were canceled, Corporate Member subscriptions were reduced, and it was decided that no new subscriptions would be accepted from subscribers other than members of the Institute. To date it has been necessary to refuse approximately 250 subscriptions.

Subscriptions to Members

As it was felt that many members received the publications who had them available in the libraries of their companies, a new membership plan was put into effect in October at the time of the yearly billings for dues. By this plan members need not, but may, subscribe to either or both publications at half rate independently of membership dues.

This change was made as another paper cut was anticipated in 1944, and in accordance with expectations a further 10 per cent reduction was made effective January 1.

The present results of the change in the membership plan indicate that we will be able to serve all new incoming members in 1944 as well as our present members.

Aeronautical Engineering Catalog

To provide a much needed service for the aeronautical engineering industry and profession, the publication of an

WITTEK

THE OLDEST NAME IN AVIATION HOSE CLAMPS

The New Boeing Flying Fortress is equipped with WITTEK *Aviation* Hose Clamps

The new Boeing B-17 G Flying Fortress with its increased fire power will add to the distinguished achievements of its predecessors. All members of the famous B-17 Series, including the B-17 G, are equipped with Wittek Aviation Hose Clamps. Today as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Co., Chicago 23, Illinois.

ARMY E NAVY

Back the Attack with War Bonds

WITTEK *Aviation* HOSE CLAMPS

AERONAUTICAL ENGINEERING CATALOG was announced in August. Paper for this publication was assured at the time of the announcement, as the paper limitation order only limited the Institute in the use of paper for its magazines. The publication of the CATALOG does not affect the allocation of paper for the JOURNAL and the REVIEW. This CATALOG will be distributed without charge to all members who request it and to a selected list of specialists in the aeronautical industry. It is scheduled for publication in May and will provide a carefully planned index to manufacturers of aircraft parts and accessories, together with CATALOG listings of their engineering specifications.

Publication Income

As the financial report for the year shows, the REVIEW has been self-supporting, and its income has been used for the support of the Aeronautical Archives and libraries. The AERONAUTICAL ENGINEERING CATALOG will be self-supporting through the listings of aircraft and engine parts manufacturers.

Personnel

During the year 1943 the Institute had to replace 57% of its employees. Most of these sought other positions at a higher wage scale. As a scientific organization, the Institute cannot endeavor to compete with commercial organizations in its salary scale for employees, but does attempt to maintain the wages set by the National War Labor Board.

The Administrative Committee wishes to express its appreciation to the loyal employees of the Institute. It is through their efforts that the services of the Institute have been maintained, notwithstanding the rapid change in personnel.

GEORGE R. FORMAN
Assistant to the President
BENNETT H. HORCHLER
Executive Vice-President
ROBERT R. DEXTER,
Secretary
JOSEPH J. MAITAN
Controller

Report of the President of The Aeronautical Archives, 1943

Included in the Aeronautical Archives are The W. A. M. Burden Library, The Paul Kollsman Library, the Aeronautical Indexes and Collections, and the AERONAUTICAL ENGINEERING REVIEW.

The Archives was organized in 1940. W. A. M. Burden loaned his aeronautical library of nearly 12,000 volumes to the Institute. Paul Kollsman and the Square D Company gave a fund of $50,000 for the organization of a free lending library. Of this amount, $10,000 was used in organizing the Library. Mr. Kollsman has increased the original grant to a permanent fund of $65,000. The income from this endowment, together with a yearly contribution of $5,000 from the Square D Company as a Corporate Member of the Institute, is used to maintain The Paul Kollsman Library.

During the year, The Paul Kollsman Library membership increased from 2,105 to 3,036, adding a total of 931 new members. The number of books loaned during the year was 1,820, and the total number loaned since the Library was established is 4,991.

Books Added to the Libraries

During the year, 3,885 books were added to the libraries. Of these, 438 were purchased, 519 were review copies of new books sent to the AERONAUTICAL ENGINEERING REVIEW by publishers, 41 were received on advertising exchange, 384 were newly bound periodicals, and 2,503 were gifts.

A collection of 1,504 books was established at Daniel Guggenheim Park at Sands Point, Long Island. While this is not in use at present because of wartime conditions, it forms part of an attractive museum and library of potential value to aircraft workers on Long Island.

The Institute libraries received 3,885 books in all during the year, bringing the total number of books in them to 23,840. The Paul Kollsman Library contains 8,764; The W. A. M. Burden Library, 11,601; the library at Sands Point, 1,504; and the Pacific Aeronautical Library, 1,971.

Aside from books, 716 *R.T.P. Translations* were received from the British Air Ministry. These were listed in the AERONAUTICAL ENGINEERING REVIEW, the first list appearing in the June issue. At the end of September, 1943, 605 requests for these publications had been filled.

New periodicals included 94 free subscriptions to Army Air Forces post papers, acquired in keeping with the policy of collecting aeronautical source

October, 1942–September, 1943

The Paul Kollsman Library

Total Library Membership	3,036
Total Number of Books Loaned	4,991
New Members During the Year	931
Books Loaned During the Year	1,840

The W.A.M. Burden Library

Days Open	269
Readers	874
Telephone Calls for Information	703
Total Users	1,577
Visitors	482

Books Added to the Libraries

	Bound Periodicals	Gifts	Advertising Exchange	Review Copies	Purchases	Totals
Books Added to The Paul Kollsman Library	44	999	41	519	438	2,041
Books Added to The W. A. M. Burden Library	340					340
Books Added to The Sands Point Library		1,504				1,504
	384	2,503	41	519	438	3,885

Volumes in the Libraries as of September 30, 1943

The Paul Kollsman Library		The W. A. M. Burden Library		The Pacific Aeronautical Library		The Sands Point Library	Totals
Accessions	8,187	Bound Periodicals	2,504	Accessions	1,971	Books 1,504	
Duplicates	288	Books	5,262				
N.A.A. Duplicates	148	Russian Books	75				
N.A.A. Bound Periodicals	141	Japanese Books	278				
		Chinese Books	482				
		Pamphlets (Approx.)	3,000				
	8,764		11,601		1,971	1,504	23,840

*AC-DC POWER SUPPLY SYSTEMS

Eclipse* AC-DC Generators . . . Carbon Pile Regulators

Design Check Chart for Eclipse AC-DC Generators and Carbon Pile Voltage Regulators

APPLICATION

Eclipse AC-DC generators provide a dependable source of alternating current for operation of various radio devices; and direct current for operation of DC electrical equipment.

They are designed to mount on main-engine generator drive pads of aircraft, now in production or undergoing design, incorporating provisions for blast cooling.

In conjunction with Carbon Pile Voltage Regulators, a controlled AC-DC power supply system is obtainable.

PERFORMANCE

The Generators are available in various capacities ranging from 60 to 200 amperes at 28.5 volts DC and 10.4 to 30.5 amperes at 115 volts AC.

Detailed characteristics are outlined in the Specification Chart on facing page.

Both AC and DC rated outputs are available simultaneously over the entire rated speed range, offering weight-saving advantages over systems utilizing separate DC and AC power supply equipment.

On twin or multi-engine installations a mixed system incorporating DC and AC-DC generators offers the same weight saving advantages and increased power.

DESIGN

Tubular armature shaft and air blast cooling contribute to dependable operation by assisting in maintenance of safe operating temperatures.

Increased strength provided by steel mounting flange.

Floating type flexible torque drive shaft absorbs torsional vibration and compensates for any slight misalignments between engine and generator drives.

Rotating field inductor permits use of stationary AC windings.

DC outputs of more than one AC-DC generator can be paralleled.

Carbon Pile Regulators provide continuous regulation without fluctuation, and with a minimum of radio interference due to absence of vibrating type regulator contacts.

★ Eclipse skills and engineering knowledge, born of many years' experience in the design, development and manufacture of complete AC Power Supply Systems — and AC ELECTRICAL EQUIPMENT for aircraft — are at the service of aircraft manufacturers for the solution of their power supply problems . . . on the warplanes of today . . . and the skyliners of tomorrow.

*TRADE MARK OF BENDIX AVIATION CORPORATION

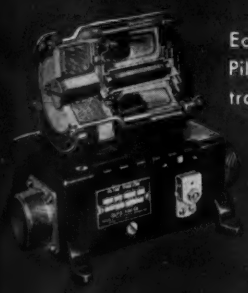
ECLIPSE

BUY MORE WAR BONDS

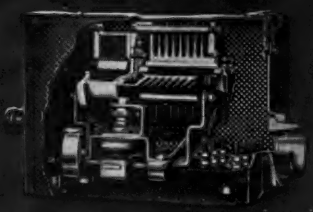
Eclipse AVIATION A

ECLIPSE-PIONEER DIVISION

Teter

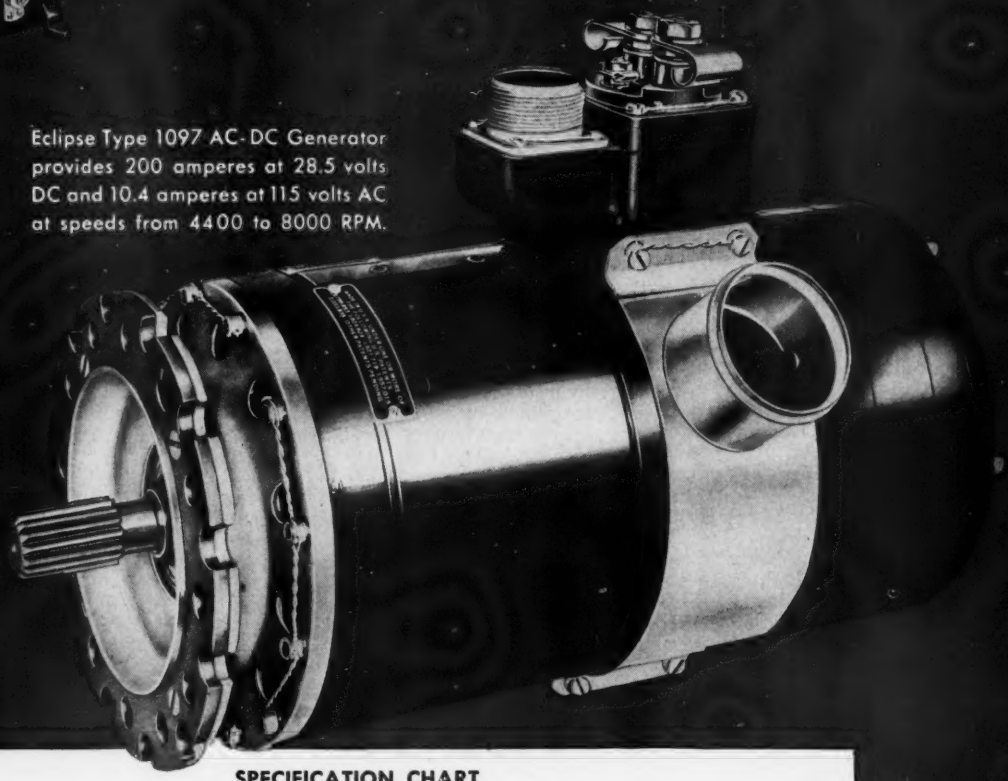


Eclipse Type 1001 Carbon Pile Regulator efficiently controls the AC voltage.



Eclipse Type 1305 Carbon Pile Voltage Regulator maintains the DC System at a constant predetermined voltage.

Eclipse Type 1097 AC-DC Generator provides 200 amperes at 28.5 volts DC and 10.4 amperes at 115 volts AC at speeds from 4400 to 8000 RPM.



SPECIFICATION CHART
Eclipse AC-DC Power Supply Systems
(Engine Driven Generators and Carbon Pile Voltage Regulators)

AC–DC GENERATORS											Carbon Pile Voltage Regulator			
Military Designation (Navy Type)	Eclipse Designation (Type Number)	RATING							Speed Range (RPM)	Wt.	AC		DC	
		AC					DC				Type	Wt.	Type	Wt.
		Volts	Amps.	Watts	Phase	Cycles at RPM	Volts	Amps.						
NEA-5	1097-1	115	10.4	1200	1	800 at 4000	28.5	200	4400 to 8000	45.0	1322-1	4.75	1305-1	4.5
NEA-7	1406-1	115	21.8	2500	1	800 at 4000	28.5	150	4400 to 8000	45.0	1322-2	4.75	1305-1	4.5
NEA-4	1310-1	115	10.4	1200	1	800 at 4000	28.5	100	4400 to 8000	32.0	1322-1	4.75	1305-1	4.5
NEA-6	1276-1	115	30.5	3500	1	800 at 4000	28.5	75	4400 to 8000	45.0	1001-5	3.75	1305-1	4.5
NEA-3	716-3	115	10.4	1200	1	800 at 2400	28.5	60	2400 to 4200	45.0	1001-2	3.75	1002-1	3.75
NEA-3	†716-13	115	10.4	1200	1	800 at 2400	28.5	60	2400 to 4200	45.0	1001-2	3.75	1002-1	3.75

NOTE: †All alternators listed above are insulated and with the exception of Type 716-13 incorporate 6" round mounting flanges with 12—$^{35}/_{64}$" holes; bolt circle diameter 5"; pilot diameter 4.122"; drive, 16 tooth involute male spline. Type 716-13 suitable for auxiliary engine application incorporates a square mounting flange with 4—$^{35}/_{64}$" holes; pilot diameter 3.249"; 6 tooth square male spline.

BLAST COOLING REQUIREMENTS: Type 716; blast equal to 5" water static plus velocity head. All others; blast equal to 6" water static plus velocity head.

ACCESSORIES

THE INVISIBLE CREW
Precision Equipment by Bendix Aviation Corporation

Teterboro, New Jersey

material of all types. The number of different periodicals received increased during the year from 156 to 400.

Reference Service

The facilities of the Aeronautical Archives were used in person by 398 persons 874 times. These 398 persons called for 2,971 books and magazines, or an average of 3.4 books and magazines per visit. There were 703 telephone calls for information, and 482 persons visited and inspected the Archives without making use of the collections for reading purposes. The Archives filled 328 orders for photostat copies, calling for 934 separate articles.

A summary of the statistical data on the libraries is given on page 51.

The card index of the Archives contains over 2,000,000 classified cards prepared by the Work Projects Administration. To this have been added 10,000 cards from the Pacific Aeronautical Library, resulting from the periodical indexing project begun there in October, 1942, under the auspices of the Aircraft War Production Council, West Coast, Inc. Cards for all aeronautical publications copyrighted in the United States and other aeronautical publications catalogued by the Library of Congress are added regularly. The biographical files contain biographical sketches and clippings about more than 16,000 persons engaged in aeronautical activities in all parts of the world. These and the files on aeronautical subjects occupy 200 file drawers, and additions of clippings from newspapers and magazines are made to them regularly.

Gifts

The continuing interest of freinds of the Archives is shown by more than 300 gifts that were received during the past year. These have been acknowledged by letter and a number have been described in the monthly issues of the AERONAUTICAL ENGINEERING REVIEW. The collections of prints, models, music and relics contributed by Mrs. Bella C. Landauer and many other friends have continued to expand through their interest.

Model Collection

The collection of airplane models has been increased by gifts from the Consolidated Vultee Aircraft Corporation, Douglas Aircraft Company, Inc., Lockheed Aircraft Corporation, and others. Lt. Col. Carl R. Borkland loaned a historical collection of 25 models. More than 250 plastic identification models were received through the courtesy of the Navy Bureau of Aeronautics and the Army Air Forces. At present, more than 450 models are on display.

Medals and Medallions

The collection was enlarged during the year by gifts of Brig. Gen. Frank P. Lahm, A. Leo. Stevens, and others. Many air events of historical significance are commemorated in the representative collection that is assembled in the Archives.

Insignia

The collection of pins, badges, buttons, wings, factory badges, and cloth insignia was greatly increased during the year by gifts from air lines, manufacturers, the air forces of several countries, and a number of individuals. The Archives now contains over 1,200 different insignia. Of greatest interest are the wings worn by American and foreign air forces and the pilots and other employees of air lines. As most of these came as gifts, the Institute again expresses its appreciation to its many friends who have added to the insignia collection.

Prints, Music, Trade Cards, Bookplates, Invitations, Calendars, and Christmas Cards

The collection is increased each year by prints of aeronautical interest which are issued by companies. Many art calendars are received, and the collection of aeronautical Christmas cards now fills nine volumes. More sheet music, bookplates, invitations, and trade cards, all having an aeronautical interest, are added each year. A collection of airline labels were added during the year as a gift of W. A. M. Burden.

Appreciation

The Officers of the Archives again express their appreciation to the many donors who have made so many valuable contributions. When all the collections can be displayed properly, they will become one of the greatest centers of aeronautical interest in the country.

LESTER D. GARDNER
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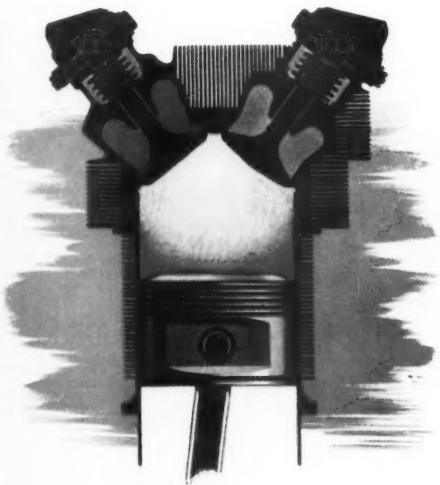
(*Continued on page 59*)

WRIGHT POWERS THE TONNAGE OF THE AIR

Utility or Waste ?



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Fuel in an engine cylinder can behave in two ways: it can burn usefully or explode and waste its energy. For best power a fuel must burn. The combustion speed of fuels has been clocked as accurately as a bullet. It's slower—only about 150 ft. per second—but this is about the right flame speed to provide proper pressures on the piston during the entire power stroke.

Detonation, which causes the familiar "knock" or "ping" in a car, results when part of the fuel burns normally and the remainder, under high pressure, explodes like a firecracker—with higher pressures, higher temperatures, and waste of energy.

The problem in engine design is to obtain maximum power at minimum consumption from a fuel without causing detonation. Ample and strategic cooling is important. So is the compression ratio and the degree of supercharging, or mixture pressure at various engine speeds. The mere use of higher octane fuel will not produce more power. The engine must be designed to take the fullest advantage of its better combustion qualities—a continuing research project in the Wright laboratories.

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Coating on two sides

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The top and sidewalls of this housing are formed from Alcoa Aluminum brazing sheet, and they are joined by merely inserting the assembly in a brazing furnace. Alcoa Aluminum brazing sheet carries its own filler material on one or both sides as required by the job. Parts are formed of this sheet just as they are with ordinary sheet. Flux is applied, the assembly is put in a jig and inserted in a brazing furnace for the required length of time. The coating on the brazing sheet melts, thus forming the filler material which joins the parts together. The job goes fast. Man-hours are low. The part is accurate, neat, rigid and strong. All of the usual advantages of aluminum are retained: light weight, resistance to corrosion, fine appearance, etc.

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To facilitate the prompt receipt of copies of the Journal and Review, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

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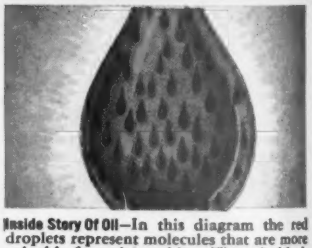
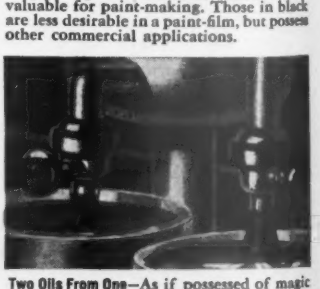


Inside Story Of Oil—In this diagram the red droplets represent molecules that are more valuable for paint-making. Those in black are less desirable in a paint-film, but possess other commercial applications.



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Electrically Driven Gyroscopes for Aircraft

H. M. WITHEROW† AND A. HANSEN, JR.‡

General Electric Company

SUMMARY

By utilizing electricity rather than air pressure to revolve the rotor and operate other parts of gyroscopic flight and navigating aircraft instruments, distinct advantages have been obtained. This has been particularly true for devices designed to operate under the severe conditions of modern warfare. In this paper the requirements and design considerations of such instruments are described.

GYROSCOPIC INSTRUMENTS are given a place of prominence on the instrument panels of military and commercial aircraft. They are among the "most used" of all the instruments and are necessary for "blind" flight since they serve as stable references in space when natural objects are not visible. This group consists of a Gyro Horizon, showing the attitude of the aircraft—that is, whether or not it is in level flight; a Directional Gyro, showing departure from course; and a Bank and Turn Indicator, indicating rate of turn.

OPERATING PRINCIPLES OF GYROSCOPIC INSTRUMENTS

Regardless of the type of power used, the gyroscopic principle and general construction of these instruments are as outlined below.

The Gyro Horizon (Fig. 1) consists of a spinning rotor with its shaft mounted vertically in a gimbal that is pivoted athwartships to another gimbal. This outer gimbal is in turn pivoted fore and aft to the main frame of the instrument. The axis of the rotor is mechanically free to tilt in any direction with respect to the instrument case, and by means of a bar and pointer relative motion of the rotor axis and the case is indicated on a dial. Since the spinning rotor tends to stay vertical, the bar and pointer show movement of the instrument case; or the aircraft, with respect to a fixed vertical.

The significance of the position of the bar and pointer is shown in Fig. 2.

In the Directional Gyroscope, the spin axis of the rotor is horizontal. The motor frame, or gimbal, is pivoted horizontally to an outer gimbal, and this is pivoted vertically to the main frame. A gear attached to the vertical gimbal drives a dial, calibrated in degrees, through a 1 to 1 ratio, and, since the spinning rotor and its gimbal tend to stay in a fixed position in space, movement of the instrument case (or of the aircraft) around its vertical axis will cause rotation of the dial (see Fig. 3). Any departure of the plane from a fixed course will be indicated by movement of the dial with respect to its index.

The gyroscope of the Bank and Turn Indicator consists of a spinning rotor with its shaft athwartships and its bearings in a frame or gimbal which, in turn, is pivoted fore and aft to the instrument frame. The gimbal and rotor assembly is restrained by a spring, and a pointer is mechanically linked to the gimbal to show direction and magnitude of its movement (see Fig. 4).

The spinning rotor tends to maintain its position in space, but, if torque is applied in the plane of the rotor axis, precession will occur—that is, the rotor will tilt in a plane 90° from that of the applied torque. The tilt will be in the direction to make the spin axis of the rotor coincide with the axis of the applied torque. Turning of the airplane thus causes precession, and movement of the pointer shows direction and rate of turn (degrees per minute). A ball bank indicator, consisting of a ball in a liquid-filled curved glass tube, is set into the face of the instrument.

The authors (H. M. Witherow, *right;* A. Hansen, Jr., *left*) examine an electrically driven gyroscope.

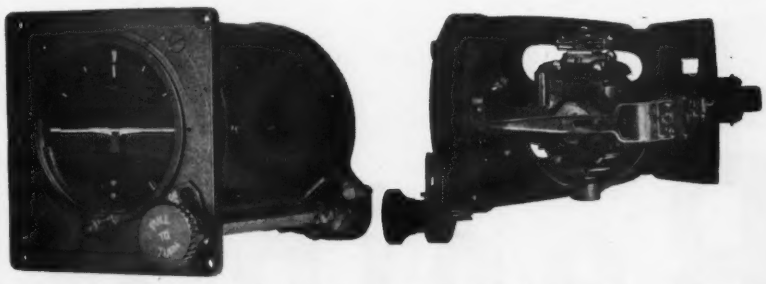

FIG. 1. Gyro Horizon Indicator. In the side view (*right*) the cover and caging mechanism are removed to show the gyroscope.

Presented at the Winter Technical Meeting, American Institute of Electrical Engineers, New York, January 24–28, 1944.

† Designing Engineer, Gyro Instruments.

‡ Development Engineer, Gyro Instruments.

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FIG. 2. Appearance of Gyro Horizon Dial or various attitudes of the aircraft. The wings represent the plane on which the instrument is installed; the bar, the horizon.

OPERATIONAL REQUIREMENTS

Instruments, such as described above, have been in common use for many years. These have been air-driven and have performed quite satisfactorily under usual peacetime flight conditions. Limitations of air operation at extreme altitudes and temperatures experienced in combat can be removed and other advantages obtained by electric drive. The trend toward electrification of aircraft also makes electrification of these instruments desirable.

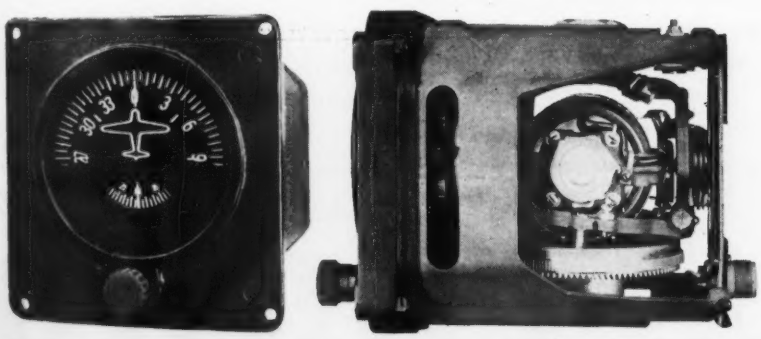


FIG. 3. Directional Gyro Indicator. In the side view (*right*) the cover is removed to show the gyroscope.

FIG. 4. Bank and Turn Indicator. The ball bank indicator beneath the gyro actuated pointer serves to indicate the proper angle of bank for any rate of turn.

The general requirements for such instruments are as follows: (1) reliable and accurate performance from +70° to −54°C. and at all altitudes to 40,000 ft.; (2) quick starting; (3) operation in excess of 1,000 hours without servicing; (4) small size and light weight; (5) accessibility of parts for servicing; (6) protection from dust and harmful fumes; and (7) ability to withstand vibration and shock.

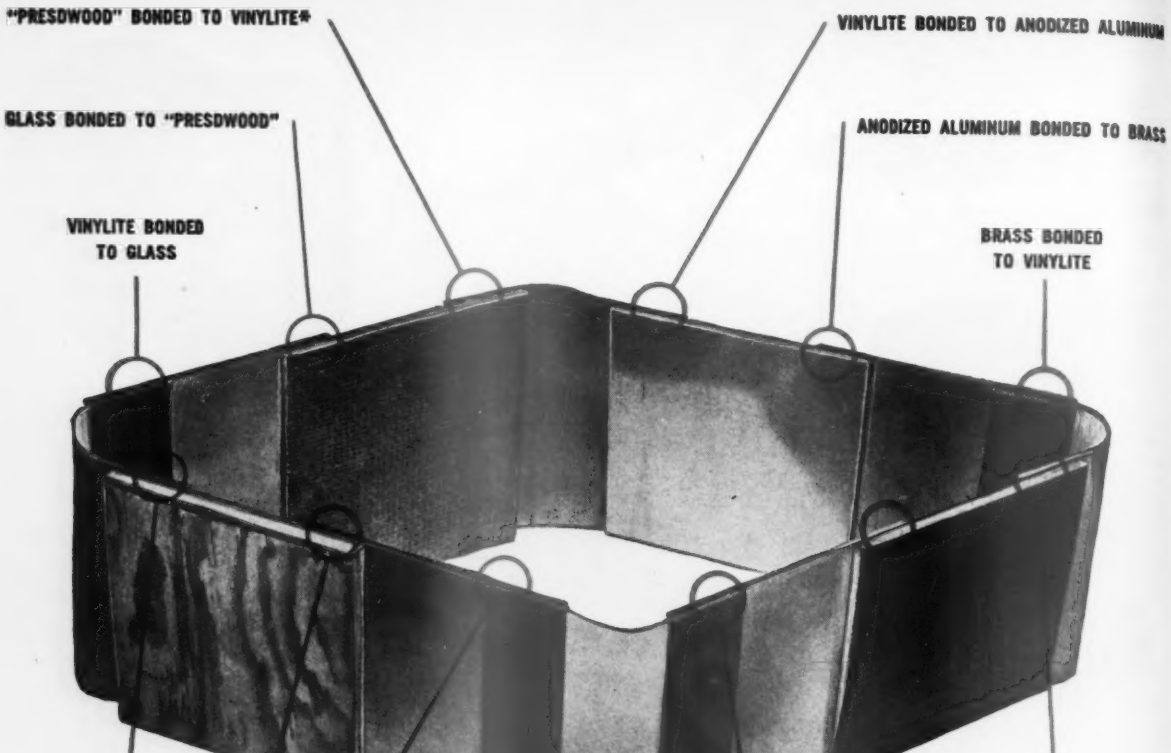
POWER SUPPLY

The selection of the type of power to be used for electrically driven gyroscopes is influenced by factors of convenience and performance. Low-voltage direct current is universally available on aircraft and would be desirable from the standpoint of application. However, the problems of commutation at high speeds and high altitudes make it impractical for sensitive instruments.

The gyro horizon and the directional gyro are essentially free gyroscopes, sensitive to balance and bearing friction. High speed is essential for stability, and the products of brush and commutator wear would rapidly affect the performance of these devices and make frequent cleaning and servicing necessary.

One hundred and fifteen volts, three-phase, 400 cycles were chosen for these instruments, since this is now available on many planes or can be made available by the installation of an inverter. Polyphase is preferable to single phase from the standpoint of simplicity of motor design and starting characteristics.

The bank and turn indicator does not require the same degree of refinement mechanically or gyroscopically as the other instruments since it is not a free gyro and indicates short time departures from normal. A 5,000-r.p.m. centrifugally regulated d.c. motor is satisfactory for this device. The design details of the bank and turn indicator are not within the scope of this paper, which deals primarily with the applica-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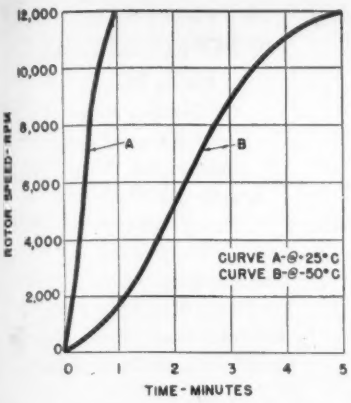

FIG. 5. Acceleration curves of 115-volt, 400-cycle, three-phase motor for gyroscopic instruments.

tion of electricity to the operation of the gyro horizon and the directional gyro.

A.C. MOTOR DESIGN

Any gyroscope has rigidity by virtue of its rotor speed and the radius of gyration of its spinning mass, the latter factor being a squared function. Since dimensional and weight limitation of the instruments fix the weight of the rotor at approximately 1 lb., it is necessary to use as high a speed as possible consistent with long life and to concentrate the weight at its outermost diameter. This latter requirement led to an umbrella-style rotor with the driving element within.

A hysteresis type of motor was chosen since it has good starting characteristics, runs at synchronous speed, and makes possible a symmetric rotor with all smooth surfaces which can be manufactured with inherently good balance. The rotor consists of a bronze cup with rings of magnet steel spun in and ground internally for concentricity and accurate diameter. The rotor assembly must be precisely balanced for good instrument operation as well as life.

The stator is wound for four poles, fixing the speed at 12,000 r.p.m. With an input of less than 10 watts, acceleration characteristics are obtained as shown in Fig. 5. Under all temperature conditions normally encountered these motors will be up to speed within the engine warm-up period, thus assuring safe performance at take-off. Fig. 6 shows the speed-torque curve of the motor.

The useful life of a gyroscopic instrument has usually been limited by the rotor bearings. In addition to speed, the factors affecting life are unit pressure on the bearing surfaces, lubrication, dimensional accuracy, and cleanliness.

A cross-sectional view of the bearing developed for the gyro motor is shown in Fig. 7. The unit pressures on the shaft pivot are kept at a minimum by forming it to a radius just slightly greater than the radius of the ball. The ball race is ground and lapped to a spherical form so that the ball track remains circular even though the center lines of the race and shaft do not exactly coincide. The contour and finish of the ball track in both the shaft and race are manufactured to exacting standards. Balls are matched for diameter and checked for spherocity within 25 millionths of an inch. Parts are cleaned and assembled in an air-conditioned area to insure absolute cleanliness.

The high torque of the motor makes it possible to use a generous amount of high-quality lubricant in each bearing with reservoir pads back of the ball race. With electric drive, the instrument case may be sealed against dust and fumes which might contaminate the bearing lubricant. There is no flow of air through the case to pull out the lubricant at high temperatures. Life tests indicate well over 1,000 hours' operation without servicing.

Bearing adjustment is extremely critical and, for good operation, cannot vary more than 0.0001 in. from optimum. To maintain this precise setting over wide temperature ranges, temperature compensation must be provided by selection of materials or by mechanical compensating means. Good results

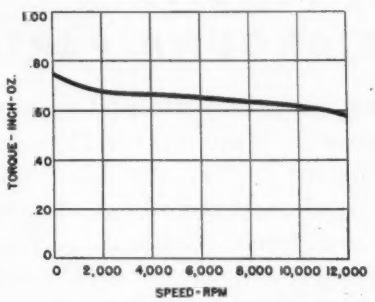

FIG. 6. Torque-speed curve, 115-volt, 400-cycle, three-phase motor for gyroscopic instruments.

have been obtained by matching the expansion characteristics of the materials used for the shaft and gimbal.

GIMBAL BEARINGS

The requirements for gimbal bearings are just as exacting as for motor bearings but with more emphasis on sensitivity and less on ability to stand up under severe service. The bearing commonly used in existing gyroscopic instruments was found to be satisfactory for this application. Accuracy of dimension and cleanliness are just as critical as for the motor bearing, and alignment of bearing race and pivot must be held to extremely close tolerances.

In the assembly of the motor and gimbals, each unit subassembly must be accurately balanced. Unbalanced torque about any axis will cause error in indication. Bearings must be set with no end play to avoid shifting weight. Materials must be selected to avoid change in bearing adjustment or shifting of the center of gravity of any subassembly with changing temperature.

Coupled with the necessity for no end play of bearings is the equally important requirement of minimum friction. Friction in the gimbal bearings causes inconsistency in the indication of the gyro horizon and drift in the directional gyro.

POWER LEAD-INS

The method of getting power to the motor through the gimbals presented some difficulties, since any extraneous torque or frictions are detrimental to the functioning of the instrument. Movable contacts add friction of too great magnitude and the probability of variable friction. Flexible leads or pigtails introduce variable torques or forces as well as insulation hazards. Small instrument type spirals, while not ideal from the standpoint of space requirements, have low uniform torque and no friction and can be well insulated. These have proved to be satisfactory, and, by assembling them to have zero torque at the normal operating positions, their effect on the accuracy of the instruments is negligible.

Slip rings and brushes are used on the vertical gimbal of the directional gyro since it must have unlimited freedom of movement on this axis. The effects of friction on this axis will usually balance out so long as it is uniform and equal in both directions.

USE AND CHARACTERISTICS OF THE DIRECTIONAL GYRO

The directional gyro and magnetic compass are supplementary instruments in that the compass indicates direction but is subject to turning errors and instability in rough air, while the directional gyro maintains a set course in a deadbeat manner. In practice, the directional gyro is used to hold course, but it is periodically checked against the magnetic compass and reset as required.

Since the gyroscope tends to stay in the position set, the perfect instrument will show drift because of the rotation of the earth. The magnitude of this drift varies with latitude. It would be zero

(*Continued on page 147*)

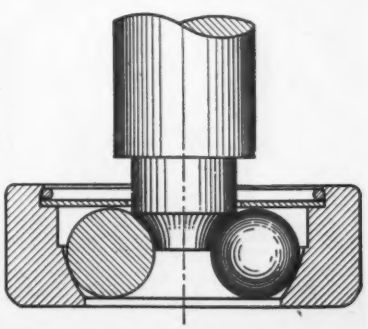

FIG. 7. Cross section of bearing for gyro motor.

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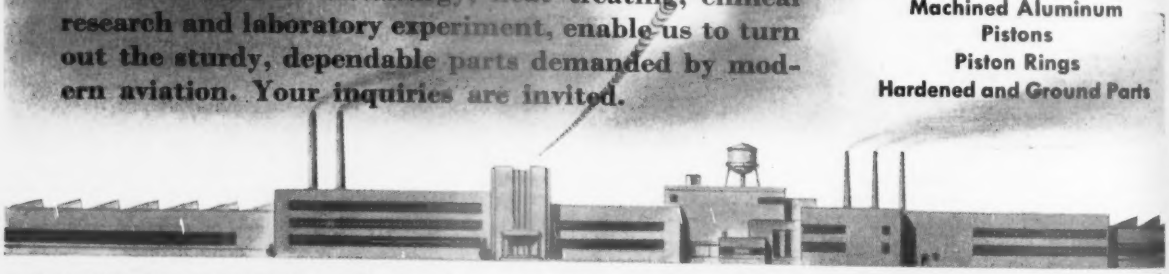

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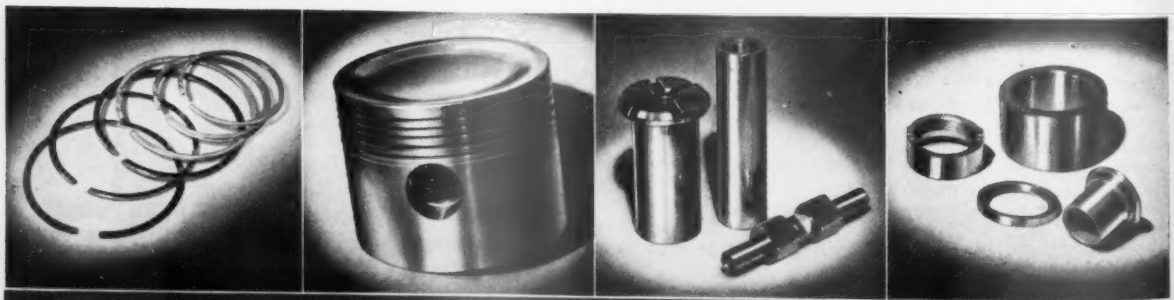

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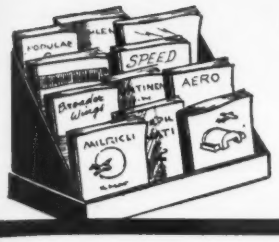


Periodicals

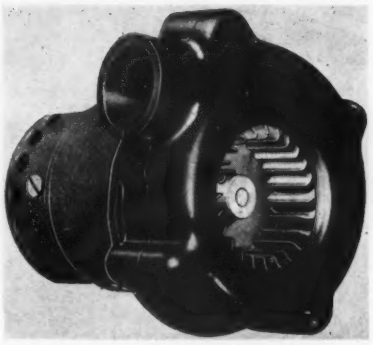
Accessories

Air Operated Dive Brakes on Torpedo Carrying Beaufighter. M. W. Bourdon. Air-operated brakes of the so-called bellows or concertina type are now fitted to the Beaufighter when it is used as a torpedo carrier. Their purpose is to permit maximum speed while approaching the target and a sharp deceleration just before the torpedo is launched. The brake mechanism and its operation are described. It is noted that the system has the advantage of simplicity and that no auxiliary power unit is required. Air pressure caused by the motion of the airplane supplies the power for operating the brakes. *Automotive and Aviation Industries*, January 1, 1944, pages 25, 31, 2 illus.

German Ingenuity. A set of notes describing different types of quick-release fasteners developed by the Germans. They include cannon-door fasteners, inspection-cover fasteners, free-filler covers, and cowling fasteners. *Aircraft Production*, January, 1944, pages 37–39, 16 illus.

Filtration of Oil. T. C. Worth. The increase in the power of modern aircraft engines has resulted in heavier bearing loads and increased sensitivity to bearing-surface imperfections. Demands for greater length of engine life have imposed new demands on the oil-filter designer. Information is given which discounts the claim that frequent changes of oil make filtration unnecessary.

Problems of oil filtration are discussed and types of oil-filter systems



Eastern Air Devices' 115-volt, 400-cycle blower unit. Running at 7,200 r.p.m., the blower circulates 22 cu.ft. per min. The total weight of the unit is 19½ oz.

are described. Consideration is given to the physical factors governing filtration, as well as to the advantages of the full-flow filter. Reference is made to how the filtration of oil, air, and numerous other fluids is studied in the laboratories of British Filters, Ltd. *The Aeroplane*, December 17, 1943, pages 695–697, 9 illus.

Test and Predicted Oil-Cooler Performance. A. L. London and J. I. Brewster. Air-side heat-transfer and pressure-drop laboratory test data are given for a shell-and-tube-type oil cooler, employing steam as the shell-heating medium. These data are compared with the information existing in the literature. The chief discrepancy observed is the surprisingly high Reynolds number obtained for transition between laminar and turbulent flow, the dip region being in the Reynolds number range 10,000 to 4,000 instead of the usually expected range of 4,000 to 2,000. The test results, together with available oil-side conductance data, are employed to predict oil-cooling performance of the exchanger as a function of air-flow pressure drop. *Transactions of the A.S.M.E.*, January, 1944, pages 75–80, 8 illus.

Aerodynamics

Seaplane Takeoff Computations. Max M. Munk. Another article in a series on the measurement of the take-off run is devoted to the seaplane. Noting that seaplane take-off occurs in two phases—the craft being converted from a predominantly buoyancy-sustained vessel to a predominantly hydrodynamically sustained vessel—the writer develops equations that refer to the run subsequent to the transition from the first to the second phase. The computations are based on data from the limited amount of available technical literature and on the analysis of actual take-off tests. They lead to an estimate of the take-off time and the maximum take-off weight. A formula is established for computing the acceleration, and a diagram shows how rapidly the acceleration of a seaplane falls off. Substitution of the acceleration into the integral for the take-off run results in the solution of the problem, giving the length of the take-off run

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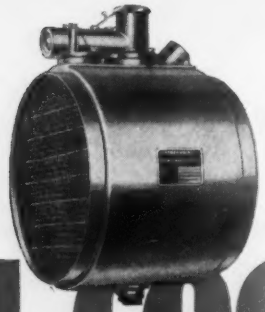

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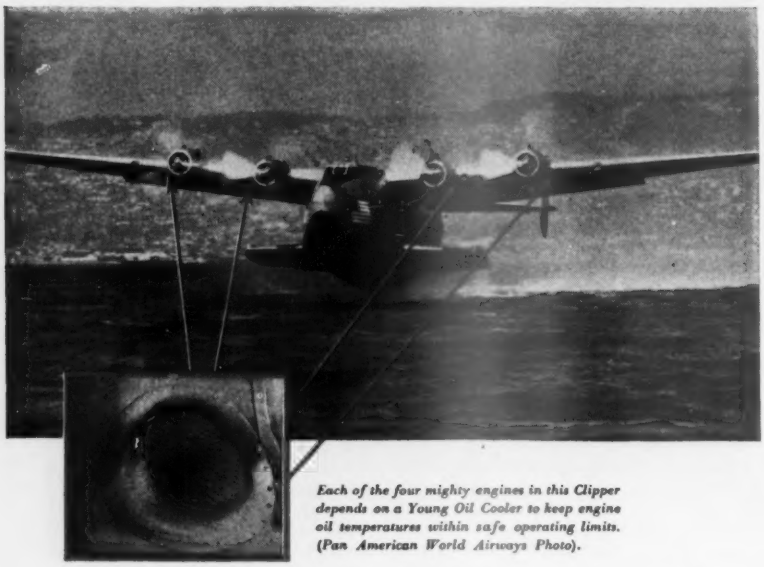

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in feet. *Aero Digest*, January 15, 1944, pages 82, 236, 1 illus.

The Lateral Stability of Aeroplanes. H. L. Price. In the sixth and concluding article of a series on a new geometric system for determining the lateral stability of airplanes, the writer works out the span-loading distribution and lift and drag coefficients of an unstalled wing in symmetrical flight, together with the wing rolling and yawing derivatives for rolling and yawing flight. The only data assumed are a knowledge of the geometry of the wing and of the slope of the lift-incidence curve of any section of the wing when referred to infinite aspect ratio. *Aircraft Engineering*, December, 1943, pages 345–351, 5 illus.

Computation of the Takeoff Run. Max M. Munk. In another of a series of articles about the measurement of the take-off performance of an airplane, the indefinite factors that make precise computation difficult are referred to, and two basic quantities are defined as the terminal or take-off velocity and the distance-average of the acceleration. Comments are made on earlier formulas that assume the acceleration to be a linear function of the velocity, suggest that this assumption may not be correct and referring to a certain C.A.A. report on a specific airplane indicating that the acceleration curve is similar to a cubic parabola. A compromise is indicated between the linear function and the cubic parabola, and a mathematical explanation is given. An improvement is suggested for computations based on one acceleration. It is concluded that the C.A.A. report, when analyzed in the manner indicated, suggests that 75 per cent of the terminal take-off speed, rather that the 70 or 71 per cent proposed by another report, must be considered to give the average take-off acceleration and that this is the most convenient method of computation and is probably as exact as any other. *Aero Digest*, January 1, 1944, pages 90, 129, 131, 2 illus.

Jettisoning Weight. P. F. Ashwood and J. M. N. Willis. Referring to earlier articles regarding the gliding ability of a crippled airplane and its chances of reaching land after being damaged by enemy action, the writers offer a more detailed approach to the aerodynamic aspects of the question. They consider the various factors governing the maximum distance that can be traveled by a gliding airplane and describe the effects of these factors. The forces acting on a gliding airplane are analyzed for conditions of still air and with allowance for wind velocity. A specific example is worked out mathematically for an airplane that has given specifications, and the results are plotted on charts to show the lift-drag ratio against the lift coefficient, the effect of weight on distance traveled, and the effect of gliding speed on distance traveled. Consideration is given to the effects of lowering the flaps. Conclusions are that, in still air, maximum range is obtained at maximum

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lift-drag ratio regardless of weight; that, with a following wind, a slight increase in range can be obtained by jettisoning weight and by a slight decrease in gliding speed; and that, with a head wind, it is undesirable to jettison weight, but a limited increase in speed will extend the range. In all cases there is no advantage in lowering the flaps. From a practical standpoint the gain in distance may be small, but it may be enough to make the difference between a safe landing and failure. *Flight*, December 16, 1943, pages 668, 669, 4 illus.

Essentials of Airplane Duct Design. Charles A. Mobley. For the purpose of giving data of value in designing duct systems for supplying air for carburetion, heating, cooling, and ventilating, the writer outlines the problems involved and his explanations facilitate the use of the information. Losses in airplane ducts are classified into the following types: (a) entry losses, (b) friction losses, (c) divergence losses, (d) corner or bend losses, (e) contraction or nozzle losses, and (f) obstruction losses. Each of these is defined and it is stated that friction and contraction losses are usually small in airplane ducts. Entry, divergence, obstruction, and turn losses are treated in considerable detail, since these are frequently high.

Design problems are analyzed with respect to internal and external expansion of the air stream and combinations of the two, amount of expansion, and the fairing required. A formula is developed for determining the amount of entry area needed. Other equations are worked out for computing the relative efficiency of a turn, and diagrams clarify the explanations. Attention is given to the design of the exit of a duct system and to the calculation of the pressure drop in the system as a whole. Sample calculations are carried out with the use of actual figures and specifications, the results being tabulated and charted. Modifications to cover the effects of special cases, such as the addition of heat by a radiator, are considered. Discussion of the application of the rules to the design of carburetor ducts closes the article. *Aero Digest*, January 15, 1944, pages 122, 124, 129, 210, 213, 24 illus.

Air Cargo

Imports by Air Total 41,000,000 Pounds. Lt. (j.g.) Langdon P. Marvin, Jr. Figures on imports by air in the year 1943 are compiled and estimated from reports of the Commerce and State departments. They are analyzed and compared with figures relating to imports by ocean surface vessels. The comparison shows that the volume of imports by airplane in 1943 was 0.072 per cent of that by ocean vessel or 1.67 lbs. by air for each long ton by ship; the value of imports by air was 5.83 per cent of the total value of ocean cargo; the average unit value by airplane was $0.035 per pound compared with $2.85 per pound by surface ship; but the cargo imported by air was 20 times as safe as by sea, and it moved from port to port at a speed approximately six times as fast as cargo on ocean vessels.

It is stated that in terms of tonnage and value these imports by air are small, but their real importance lies in the nature of the materials and the timing of their arrival. Priorities are granted for strategic materials urgently needed in war production, such as mica, quartz crystals, tantalite, columbite, beryllium, industrial diamonds, rare drugs, and other materials for war purposes. Credit is given for the work performed by the Army Air Transport Command and the Naval Air Transport Service, without which the record could not have been made. The system by which priorities are granted for air shipment is explained, as well as the functions of different Government agencies that cooperate in the purchase and delivery of goods imported by air. Comparison is made between the capacity of a cargo airplane such as the Mars and the sailing ships of the early years of American foreign trade, and between the total value of imports in 1812 and air imports in 1943. *American Aviation*, January 15, 1944, pages 20, 38, 39, 3 illus.; "Imports by Air as of Today," *Air Transportation*, January, 1944, pages 5–12, 5 illus.

Air Cargo. Harry S. Pack. After indicating the loading and unloading problems that are presented by the layout of the Douglas DC-3 transport plane, the writer advises air cargo shippers on ways in which they can help the air lines to expedite the movement of materials. The points of importance are summarized as follows: (1) Use the most modern, lightweight materials in packaging at all times; (2) pack compactly and securely—keep parcels as small as possible; (3) make a survey or have a box manufacturer make a survey of the packaging problems involved in shipping products by air; (4) check packages of questionable size with the air line or air express agent before sending it to the field; (5) ship when ready. To let parcels accumulate all day until a load is obtained creates a bottleneck during the busiest hours at the airport. Permissible loading and maximum cargo dimensions for the DC-3 are tabulated. *Flying*, February, 1944, pages AC-5–AC-7, 6 illus.

Air Cargo's Breadth Underscored by Foley. E. J. Foley. In this article on problems of future air cargo transport the writer gives some ideas that are intended to provoke a realization of the scope of the field that the air transport industry proposes to encompass. He advises against undue concentration on only a few phases of the whole subject. *American Aviation*, February 1, 1944, page 68, 1 illus.

How to Use Evans' Skyloader Gear. Edward S. Evans. Adopted by the Army Air Transport Command and the Naval Air Transport Service, Evans Skyloader equipment is credited with saving time and increasing the security of cargo carried in military transports. Details are given about the use of the rope hook, which eliminates the tying of knots; the rod-beam-lock-jack assembly; and the 12-in. rod, which is combined with a mustache hook, lock, and rope for the securing of heavy equipment. *Flying*, February, 1944, pages AC-8–AC-11, 13 illus.

How to Ship Air Express to Mexico. Procedures for filling out the necessary forms for air shipments from the United States to Mexico are explained. Instructions are given for complying with the regulations of the two major air lines carrying scheduled cargo between the United States and Mexico—American Airlines and Pan American Airways. Fees and services are noted. *Flying*, February, 1944, pages AC-22–AC-24, 3 illus.

Why Shouldn't Freight Forwarder Help Build U.S. Air Cargo Future? H. E. Nachbur. The value of the foreign freight forwarder to air transportation companies is discussed. It is stated that British experience of the past points the way to the usefulness of the forwarder. The suggestion is made that American air transport companies appoint foreign freight forwarders as their agents and grant them a commission. Four important advantages that could be gained by doing this are outlined. A form of contract between an air line and a freight-forwarding firm is reproduced in full. *Air Transportation*, January, 1944, pages 33–34, 1 illus.

The Proper Use of Fiber Boxes. J. D. Malcolmson. The advantages of using corrugated and solid fiber boxes for air transport shipping containers are cited. Supplemented by suggestions for their correct use, the adaptability of these boxes for air shipment purposes is discussed under the following points: weight, cost, resistance to compression, resistance to impact, shock absorbency, insulation, and water resistance. In addition, Railway Express Agency regulations covering containers for air freight are reported, and the proposal is made for the air lines to take immediate steps in the development of a uniform packaging specification. *Flying*, February, 1944, pages AC-16–AC-18, 4 illus.

Air Power

Pacific Strategy and the Bombing of Tokyo. This article is concerned with speculation upon the direction from which major bombing operations against Japan will be conducted. Obstacles peculiar to three routes that could be adopted by the United Nations are demonstrated. The routes are: the northern, following the Aleutian archepelago; the eastern, across the Pacific via the Hawaiian Islands; and the western, from the Chinese coast. With the conclusion that the route from the south—wresting islands one by one and reversing Japan's strategy—is the most plausible, the paths along which the

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United Nations will progress to get within active bombing distance of Japanese industrial centers are predicted. This route starts from Australia, extends up through the islands of the southwest and central Pacific, and compasses the capture of the Philippines and the joining of MacArthur's forces with those of Stilwell and Mountbatten. It is stated that Japanese holdings in the Dutch East Indies and on the mainland above and beyond Singapore would thus be isolated, making possible the founding of adequate bases and supply lines on both the Chinese coast and in the Philippines for use against Formosa and for the eventual knockout blow on Tokyo.

Emphasis is placed on the fact that amphibious operations, with air power as a major factor, will be necessary for the accomplishment of the plan. In predicting the strategic scheme, the importance of several islands and regions is pointed out—notably the islands of Palau and Truk. Progressive changes in fighting tactics, which will be necessitated by northward movements, and the establishment of training bases in China are mentioned. *Aero Digest*, January 1, 1944, pages 51–55, 177, 178, 5 illus.

The Command and Employment of Air Power. Capt. H. A. DeWeerd. Methods of employing air power and the integration of air power with the overall control of military operations are discussed. *U.S. Air Services*, January, 1944, pages 11–13, 1 illus.

The Misuse of Air Power. Brig. Gen. Henry J. Reilly. The writer charges that, by the dispersal of air power through attacks on numerous areas at the same time instead of its concentration on vital areas one at a time, the United States is delaying the winning of the war. Opposing Douhet's theories, he explains why he believes that decisive victory can be effected only by the tactical application of air power in support of ground troops. As evidence of the soundness of the theory he advocates, he points to Germany's use of aviation and Russia's air support of ground forces. Every United Nations' defeat since the war began is blamed upon an insufficiency of ground forces at the front. It is the writer's opinion that, if all available air power had been massed in support of the ground troops in the African theater, Italy would not still be largely in German hands, Russia would not have fought through the campaigns of the past year without decisive help, that the Balkans could have been invaded, and that Germany would not have had time to strengthen her defenses. *Flying*, February, 1944, pages 21–23, 86, 94, 158, 159, 3 illus.

War in the Air! Hanson W. Baldwin. Continuing his monthly reports on the role played by air power in the course of the war, the writer reviews bombardment operations undertaken against Germany in the later part of 1943 and analyzes their portent. The progressively greater air attacks are described as a prelude to land invasion,

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MORE BOMBS! As bombing missions have grown in intensity, the Liberator's bomb loads have increased so that today it carries ten tons of bombs tucked away in its belly to rain block-busting havoc on enemy objectives. Oil fields, railway yards, munitions plants have felt their destructive power.

MORE FUEL! Stored in bullet-sealing fuel cells in the wings and fuselage, the fuel supply of the Liberator gives it extra-long range. Fuel cells built by "U.S." fly with the B-24 in every war theatre—protect the greater gas supply against enemy gunfire.

MORE POWER! The four engines of the B-24 of 1940 weighed 9,636 pounds. In 1944 the Liberator power plant including turbosuperchargers weighs 11,572 pounds. "U.S." Tires are lighter and stronger to carry the heavier load.

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These are only a few of the many United States Rubber Company products that have been developed with the help and cooperation of the Materiel Command, Army Air Forces and the Technical Staff of the Navy Bureau of Aeronautics. These products, many of them created in "U.S." laboratories, are today serving through science that men may live to build a better world.

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the purpose of which is to "soften up" the enemy as much as possible. However, the writer points out that as yet it is impossible to determine just how much Germany has been weakened by these attacks. He differentiates between the morale-affecting results of Royal Air Force night raids and the accurate precision results against industrial targets which are obtained by United States day bombers.

The tonnage of bombs dropped, the number of United States or British bomber losses, and the estimated number of German plane losses during August, September, and October are listed for the U.S. Eighth Air Force and the R.A.F. Bomber Command. Other phases of the air war touched upon in the article are: the creation and operations of a new American Air Force, the Fifteenth, in the Mediterranean; the possibility of shuttle raids between Britain and Russia; the antisubmarine operations of escort carriers; and the performance of carriers in the Gulf of Salerno landings in Italy, in the Pacific War, and in attacks on German shipping off the coast of Norway. *Skyways*, February, 1944, pages 26, 27, 64, 81, 7 illus.

Divert and Conquer. Alexander Kiralfy. A discussion of the flexibility of Allied air power, in which the relationship between main and diversionary operations is explained. It is shown how the air forces of the United Nations can now be maneuvered against the Axis from points all around the perimeter of Nazi-controlled Europe—strategically withdrawing German plane defensives from one place to another, cooperating with land fronts, and quickly changing diversionary fronts to main fronts where necessary. *Flying Aces*, March, 1944, pages 18, 19, 60, 62–64, 5 illus.

Airborne War or Airborne Peace? Pylon. The writer discusses the importance of air-borne forces in this and future wars. It is predicted that the next war will be won by the side that makes the best use of these forces. The history of Great Britain's air-borne forces is traced, and the equipment used is listed. The dimensions of the Horsa and the Hadrian gliders and the Douglas Dakota planes are given, as well as information about the motor vehicles, field artillery, and other equipment employed. *Aeronautics*, January, 1944, pages 42, 43.

Air Safety

Safety Has No Substitute. Irving G. McCann. With extensive experience in the investigation of air accidents, the writer reviews their causes and suggests preventive measures. Examples are given of accidents where the cause was found to be carelessness on the part of the pilot and other accidents where the cause was proved to have been improperly charged to pilot error. Some of the mistakes made by experienced flight-control officers are attributed to momentary carelessness or failure to obtain the required authority. Remedies are suggested in the form of a moral for the pilot and for the controller in each instance. Cases in specific accident reports are considered under the headings of ice, turbulence, airport traffic, airway traffic, and vanity on the part of pilot or control officer. *Air Transport*, January, 1944, pages 20–23, 2 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Air Transport

Passenger Comfort Aloft. Scholer Bangs. Noting that the comfort of passengers, absence of airsickness, and removal of other physical and mental drawbacks to air travel will be reflected in greatly increased demand for air transportation after the war, the writer reviews the extensive research conducted by Dr. A. D. Tuttle, Medical Director of United Air Lines, over a period of 5 years from 1938 to 1942. These studies show a continuous decline in airsickness, oxygen want, ear trouble, nervousness, and miscellaneous discomforts, while annual passenger traffic totals increased steadily. Tabulated results demonstrate that the average incidence of airsickness for the 5 years was 1.9 per 1,000 passengers; oxygen want, 1.0 per 1,000; ear trouble, 0.6 per 1,000; nervousness, 0.4 per 1,000; and miscellaneous, 0.9 per 1,000. Some of the improvement is attributed to a more accurate system of reporting in the later years and also to the fact that a large percentage of the passengers came from the armed forces and were presumably more physically fit than the average civilian. Better equipment, careful flying, and greater efficiency of stewardesses and air-line crews are given credit for most of the gain. A table classifying such comfort factors as angle, acceleration, vibration, noise, ventilation, etc., is expected to serve as a guide for air-line operators in the resumption of peacetime passenger service. *Air Transport*, January, 1944, pages 24–26, 7 illus.

Atlantic Steppingstone. John Norris. The importance of the Portuguese agreement to cede to Britain air and naval base sites in the Azores is interpreted. In addition to the strategic location of such bases for antisubmarine activities and as an aid to reenforcing the United Nations' military supply lines, it is shown how they will facilitate the use of the islands in civil air transportation after the war. The fact that the new bases will release considerable numbers of auxiliary aircraft carriers for duty in the Pacific is mentioned. *Flying*, February, 1944, pages 33, 144, 148, 1 illus.

Civilian Airline Maintenance Under Wartime Conditions. E. L. Warner, Jr. A description of how the commercial air lines are keeping their planes flying with safety under the handicaps of war. Information is given about the comprehensive maintenance program practiced by these air lines. Preventive maintenance operations are described, and illustrations show how the maintenance of transport planes and engines is being carried out. *Automotive and Aviation Industries*, January 15, 1944, pages 17–19, 80, 82, 84, 10 illus.

Teamwork Pays Through Air Traffic Conference. M. F. Redfern. The organization, history, present work, and future plans of the Air Transport Conference of America are reviewed as a demonstration of the results that can be accomplished by a cooperative effort to solve air traffic problems. The development of air transport is traced briefly from the first air-mail flight in 1918, with comments on the benefits achieved through teamwork, the extension of Government regulation, and the growth of the activities of the Conference. The contributions of Conference executives and other leading figures in the industry are noted, and plans are outlined for handling the expanded traffic after the war. The article includes a chart of the present organization of the Air Transport Association of America, of which the Conference is a part. *Air Transport*, January, 1944, pages 27–31, 9 illus.

Future of the Flying-Boat. In reference to the further development of aircraft for British transoceanic services, it is suggested that the development of the potentialities of the flying boat be considered, as well as the new types of long-range landplanes now on the drawing board. It is stated that one objection to the use of the flying boat is the limited number of bases in Great Britain and the distance many of these are from London. Nevertheless, a number of advantages justify further investigation of claims for the flying boat.

It is further stated that this type of aircraft design offers more scope for the development of large planes and that the flying boat gains in relation to the landplane, both as to aerodynamic efficiency and structural weight, as the size increases. Problems of profile drag and wing loading are discussed, and possibilities in the future development of base facilities for flying boats are considered. *Modern Transport*, January 8, 1944, page 7, 1 illus.; "Flying Boats," page 27, and "Marine Aircraft and the Future," page 57, *Aeronautics*, January, 1944.

Cruise Control for Flying Efficiency. Part VI. R. Dixon Speas, Jere T. Farah, and Sanford Hinton. This is

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Martin-Developed Flooring Saves Precious Pounds in Planes

Despite its lightness, Martin plastic flooring is strong, rigid. Here a thin sheet supports a girl's weight without bending or sagging.

A NEW plastic flooring, which will permit airlines to carry hundreds of pounds more payload, is the latest in the parade of developments coming from Martin laboratories. Through a licensing agreement with The Glenn L. Martin Company, this lightweight plastic flooring is now being manufactured by the Panelyte Division of the St. Regis Paper Co.

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Made from laminated phenolic sheet reinforced with aluminum alloy strips, this new flooring weighs approximately ¼ lb. per sq. ft. *less* than other types of flooring of equal strength and carrying capacity. To equal the strength of this product weighing .885 lbs. per sq. ft., it would be necessary to use a plywood flooring weighing 1.15 lbs. per sq. ft., or a corrugated metal flooring weighing 1.28 lbs. per sq. ft.—nearly half again as much.

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Since the flooring area of a modern 24-passenger airliner is approximately 1700 sq. ft., this represents a weight savings of 143 lbs. Translated into terms of passengers and cargo, this weight saving, over the life of the plane, adds up to the sort of figures that no postwar airline operator can afford to ignore.

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In addition, this new plastic is ideal for catwalks, benches and table-tops. Either smooth or rough finish to prevent slipping, and in varying thicknesses.

Now saving precious weight in Martin-built war planes, this flooring development promises great things for the future, not only in commercial aviation, but throughout all industry. Once again Martin research is blazing the trail to tomorrow!

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the sixth article in a series on how to obtain maximum flight efficiency in airline operations through the proper control of airplane power. This installment is concerned with some current problems that must be solved in order to apply efficient flight control to practical operations. The outstanding needs for future development are given under four general headings: simplification of procedures, improvement in accuracy of fuel-consumption indicators; improvement in specific fuel consumption qualities of aircraft engines; and improvement in flight dispatch procedures. In summation, it is reported that the problems of improving cruise control mainly involve equipment efficiency. *Aviation*, January, 1944, pages 227, 318, 321, 322, 325, 3 illus.

Airplane Descriptions

The Miles "X." Descriptive data and specifications are given on the Miles "X" design. Intended primarily for a long-range transport aircraft, this design is characterized by the manner in which the fuselage merges into the wings, reducing interference between wing and fuselage and affording a large cross-sectional space in the interior for passenger and freight accommodations. Eight engines, driving four contrarotating propellers by means of long extension shafts, are provided. The cruising speed of the Miles "X" is projected at 350 m.p.h.; the maximum speed at 425 m.p.h. Its span is given as 150 ft.; wing area, 2,350 sq.ft.; loaded weight, 130,000 lbs.; wing loading at take-off, 55.2 lbs. per sq.ft.

Although three civil versions of the "X" have been forecast, the article deals mainly with two: a long-range version, with a range of 3,450 miles; and a medium-range version with a range of 2,000–2,500 miles. *Flight*, December 23, 1943, pages 703–705, 6 illus.; "Plans of Miles 'X' Transport Revealed," *Aviation*, January, 1944, pages 242, 343, 346, 349, 350, 353, 357, 2 illus.; "New Design by Miles," *Canadian Aviation*, January, 1944, pages 67, 97, 2 illus.; "Super Air Liner British "Miles" "X"," *Commercial Aviation*, December, 1943, pages 62, 64, 3 illus.

Two Japanese Aircraft. Illustrations and brief descriptions of the Mitsubishi S-003 fighter and 01 bomber are furnished. The S-003 is reported to be a new type of naval fighter powered with an in-line engine instead of the usual radial design. The plane is stated to be a development of the S-002. It is powered by a Daimler-Benz 601, inverted "V" engine of about 1,400 hp., giving a speed of about 370 m.p.h. and a higher combat ceiling than the predecessor. Armor and self-sealing fuel tanks are fitted. Armament consists of two 0.5-in. machine guns in the cowling, a 20-mm. cannon firing through the propeller hub, and machine guns in the wings on which details are not given. It is explained that the S-003 represents the Japanese version of the type of fighter corresponding to the American Hellcat and Corsair but that it is not in so high a state of development as these aircraft.

The Mitsubishi 01 is described as a bomber and torpedo plane. It has a wing span of 80 ft. and is fitted with two Kinsei 14-cylinder radials developing about 1,000 hp. The bomb load is 3,300 lbs. or one 18-in. torpedo. Armament includes 7.7-mm. machine guns, and a 20-mm. cannon may be used in the tail position. The maximum speed is 275 m.p.h. *Aeronautics*, January, 1944, page 33, 4 illus.

Elements of Flying Boat Design. A brief survey of the fundamental principles of flying-boat design. Features of types manufactured by the British, Americans, Germans, Russians, and Japanese are examined. The article includes a table of particulars on flying boats of various nations, listing the type, span, length, wing area, total power, empty weight, loaded weight, wing loading, power loading, and maximum and cruising speeds. *The Aeroplane*, December 3, 1943, pages 642–645, 8 illus.

The "Helldiver" Meets South Pacific Battle Tests. With the release of additional information about the Curtiss SB2C-1 Helldiver, known details on the bomber are summarized. Major design features are briefly reviewed. Some of the changes incorporated in the series now in service are reported: the complete revision of the combat equipment and combat-loading features; the addition of 150 lbs. of armor plate behind the pilot and around the gunner; the installation of self-sealing fuel tanks and protected fuel and oil lines; redesign of the flap mechanism to enable the pilot to open or close the flaps three times faster than on the early experimental model; and changes in radio equipment. The article also includes data on the subcontracting program by which it is built. *Aero Digest*, January 15, 1944, pages 56, 57, 3 illus.

The Farner W. F. 12. Details are given on a Swiss design for a two-seater trainer and touring aircraft. A high-wing monoplane with a fixed and faired undercarriage and a nose-wheel landing gear, the Farner W. F. 12 has side-by-side seating accommodation with dual controls. Its maximum speed is 109 m.p.h.; its landing speed, 46.6 m.p.h. The power-plant installation of the W. F. 12 is noted as its outstanding feature. A British Cirrus-Minor four-cylinder, air-cooled, in-line engine is mounted in the fuselage aft of the cabin. Comprising two parts that are linked together and connected with it by means of universal joints, the propeller extension shaft runs over the top of the cabin and is supported forward in a structure projecting ahead of the top of the fuselage nose section. *Flight*, December 9, 1943, page 647, 1 illus.

Why Send a Boy? B. J. Vierling. Modifications are given to the specifications for a "short-haul" or a feeder-line passenger and cargo plane, reported in an earlier article by Charles Froesch, Chief Engineer of Eastern Air Lines. In addition to a general description of the passenger and cargo capacity, range, performance, operating economy, crew, safety devices, and maintenance requirements, specific provisions are outlined for passenger, cargo, and baggage accommodations and other details. *Air Transport*, January, 1944, pages 53, 54, 1 illus.

A-20 "Havoc." T. R. Smith. Continuing an engineering reference series on various military planes, this is a detailed study of the Douglas A-20 fighter bomber. Numerous diagrammatic drawings, photographs, and tables of dimensions and weights illustrate the design analysis of the aircraft's components. Emphasis is placed upon the planned versatility of the A-20 and the specific design features that lend themselves to this characteristic.

In its present series the Havoc (or Boston as it is called by the R.A.F.) is described as an all-metal midwing monoplane, powered by two 14-cylinder 1,600-hp. Wright engines. Its overall wing span is given as 61 ft., 4 in; overall length, as 47 ft., 4 in., with the bombardier nose, and 48 ft. with the attack nose; and overall height, at rest, as 18 ft., 1 in. Examination of the construction details reveals data on the seven major components of the A-20 (the nose, main fuselage, empennage, right and left inner and outer wing panels), and the five major sections of the fuselage, consisting of attack or bombardier nose, pilot's cockpit, bomb bay, gunner's compartment, and tail compartment.

Tabulated specifications and drawings aid in the description of the construction details. *Aviation*, January, 1944, pages 125–146, 41 illus.

Airports

Portable Runways. A description of the square-mesh tracks developed by the British Reinforced Concrete Engineering Company, Ltd., for airdrome runways. These portable runways are composed of welded netlike sheets of high-tensile steel, manufactured from hard-drawn steel wire. At present they are supplied in rolls which, when laid, measure about 75 by 7 ft. Clips made from hot-rolled mild steel are employed to fasten sections together.

Among other things this type of runway is recommended as decreasing the effects of mud upon the aircraft. It is also claimed to cause a lesser amount of tire wear than previous net types of runways. The article includes some brief data on the camouflage of the portable runways, as well as an illustration of a tool developed by the same company for turning wire projections on the perimeter of the track, thereby eliminating the possibility of puncturing tires if an airplane should run off the sides. *The Aeroplane*, December 10, 1943, page 667, 2 illus.

Airports and Air Traffic Control. Glen A. Gilbert. In the concluding article of this series some of the air-traffic control problems related to the

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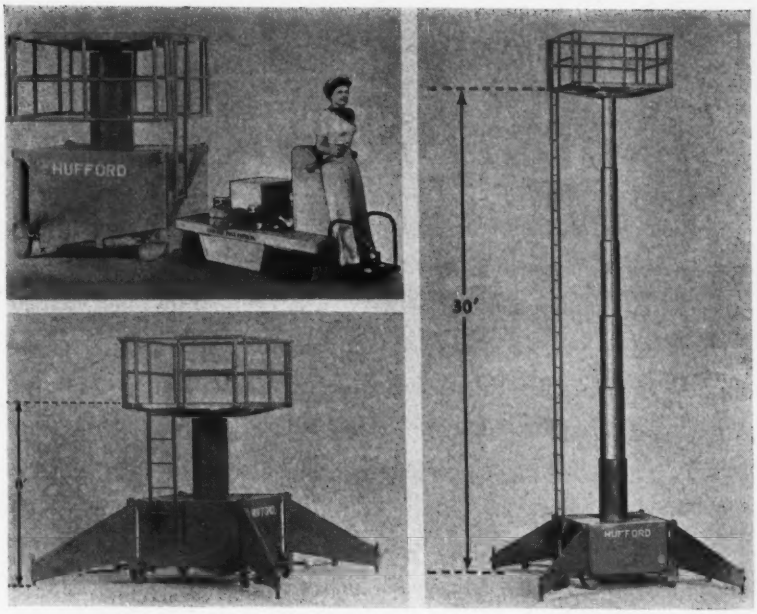
location of airports serving a given metropolitan area are examined. Points covered in the preceding articles are summarized. The discussion deals with the avoidance of conflicting traffic patterns in the establishment of multiple airport systems and with the location of airports so that maximum capacity is realized under instrument-weather conditions. Divided into ten items, the summary consists of advice relative to air-traffic control problems. *Flying*, February, 1944, pages AC-20, AC-21, AC-25, 6 illus.

A Landing Gear "Yardstick" for Postwar Airport Layouts. J. H. Geisse. The thesis of this article is that airport design could be greatly simplified, with accompanying advantages in cost and accessibility, if the landing gear of aircraft were designed to meet the limitations of single-runway fields.

By details on several types of proposed landing gear it is shown how undercarriages might be designed for safe cross-wind landings without involving any sacrifice of airplane performance or any material increase in manufacturing costs. The described types include a four-wheel landing gear with differential control of castering, as well as a tricycle landing gear for adaptation to present designs, in which castering of the main wheels is controlled by springs and castering of the single wheel by a rudder bar.

After explaining how changes in landing gear might be effected to comply with limiting airport factors, the writer goes on to emphasize the desirability of single-strip runways. In addition to considerations of accessibility and costs, he discusses the greater number of landing facilities, the added convenience and safety, the relief of traffic congestion, and the increase in station service which can be achieved with this type of airfield. *Aviation*, January, 1944, pages 120, 121, 343, 345, 346, 349, 350, 353. 358, 359, 6 illus.

Airports for London. Urging that an immediate program be instituted for the establishment of postwar London airports, this article discusses some of the problems meriting major consideration in such a project. The points are made that: the land and location must be found to fit the requirements of the airport, rather than the airport built to suit the site; considerable cost and a great deal of land adaptation will be necessary; primary emphasis should be on the runway layout and length, lighting and blind-approach equipment, and maintenance facilities rather than on buildings, administrative offices, and restaurants; and there is much room for development in the design of airport equipment and control facilities. Methods of segregating traffic are examined and several airport plans are mentioned in connection with their possible adaptability for London. Of these, the tangential runway system—proposed by American Airlines as an alternative for New York's Idlewild Airport—is recommended as worthy of investigation and experiment in Great Britain. The projected Miles and Isle of Dogs airports are judged inadequate for London's needs. *The Aeroplane*, December 24, 1943, pages 724, 725, 4 illus.



This Hufford Machine Works portable elevator is claimed to be capable of raising 3,000 lbs. 30 ft. Designed to pass through a 6-ft. aisle and an 8-ft. door, the lift can be used for a variety of aeronautical factory and field operations.

Aviation's Living Space. Thomas H. Bourne. The problem of directing traffic in the air in the postwar period is discussed. It is stated that the present system of directing traffic is rapidly becoming obsolete and is reaching its saturation point. It is explained that the development of an automatic system combining transmission and posting of flight data was started by the C.A.A. in 1938, and in 1942 the first experimental unit was installed at the Washington National Airport. Details of the system are outlined. Reviewing the three major air traffic bottlenecks to air transportation development—airway capacity, airport capacity, and air traffic control capacity—the following conclusions are reached:

(1) Airway capacity will be sufficient to accommodate the expected traffic of 1950 if technical developments such as vertical separators, increased cruising speeds, pressure cabins, and improved radio facilities are available as the demand for air transportation increases.

(2) Airport capacity will be sufficient only if adequate instrument-landing facilities are provided and if adequate planning and construction are commenced immediately on the parallel runway, multiple airport facilities that each major terminal will need.

(3) Air traffic control capacity will be sufficient only if complete installation is made of the new automatic control systems. *National Aeronautics*, January, 1944, pages 22, 52, 1 illus.

Armament

Nazi Rocket Weapons. Roy Healy. Reference is made to the large amount of research being carried out by the Germans for the development of rocket- and jet-propelled weapons. It is noted that reports come from the war fronts of German fighter planes equipped with rocket shells, of jet-propelled "flak," of rocket-accelerated armor-piercing bombs, of rocket glider bombs, of jet-assisted take-off, of rocket planes and thermal air jet planes, of large fragmentation and chemical rockets used by ground forces, and, of late, the threat of retaliatory bombing of England with long-range super rockets. Germany's new tactics of "air-to-air" bombing and use of rocket shells against Allied bomber formations is discussed. What has been learned about German explosive rocket shells from pieces recovered from Allied aircraft and from captured German equipment is related. Rocket-launching equipment is described and illustrated. *Astronautics*, December, 1943, pages 3–5, 4 illus.

Strategic Bombpower. George Stromme. A discussion concerning the progress of bomb design in which it is explained how bomb techniques and bomb types are varied for different kinds of targets. With reference primarily to the Eighth Air Force, steady increases in concentrated bombpower during the past year are attributed to two prime reasons: (1) better data for calculating the bomb ingredients in each assault; (2) increase in weight of assaults (or additional "prong" operations) by virtue of increased production. The article includes brief descriptions of the three basic types of bombs—fragmentation, demolition, and incendiary—and the

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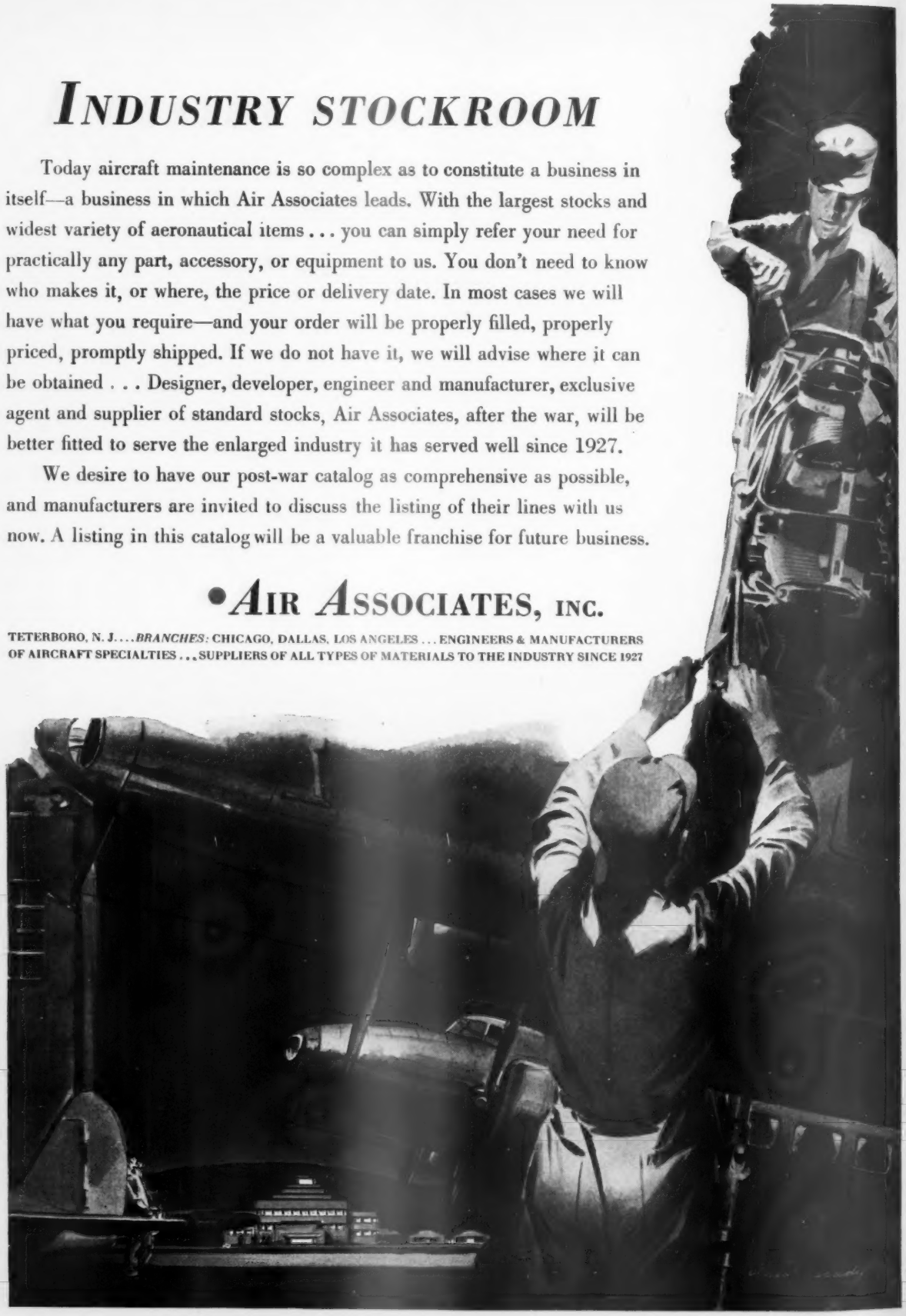

specific purposes for which each is intended. *Western Flying*, January, 1944, pages 38, 39, 84, 4 illus.

Russian Rocket Bomb. A sketch and brief description are given of the Russian rocket bomb that is launched from aircraft against German tank columns. It is stated that a velocity of 800 ft. per sec. gives the projectiles a penetration of 7 in. of armor plate. *Astronautics*, December, 1943, page 8, 1 illus.

Radio-Controlled Rockets. G. W. Walton. In this article the view is expressed that the knowledge gained from rocket research will probably make possible the construction of a rocket weapon that will be supreme. It is predicted that if this is accomplished the use of all other weapons (including aircraft) for anything like the same results will be grossly extravagant in raw materials, time and man power, equipment in manufacture, operative service personnel, and casualties.

A historical outline is given of the development and efficient use of war weapons. The principles of rocket design are discussed and the advantages of the radio-guided rocket-propelled explosive missile are explained. *Aeronautics*, January, 1944, pages 36–39.

Avigation

Precomputed Sunline Approaches in Celestial Avigation. Capt. James B. Rea. This article gives what is called an accurate and scientific method for making an approach to a given geographical location when only one celestial body is available. The problem involves finding a small island in the ocean, located beneath low-lying clouds, during daylight hours when only the sun is available, assuming the failure of radio and direction-finding apparatus. With the aid of diagrams, a typical example is given, with detailed instructions for making the computations and for checking them to eliminate errors. In summarizing the factors, the writer emphasizes that the ideas involved should be remembered rather than the rules governing the particular case used as the example. *Aviation*, January, 1944, pages 334, 338, 342, 3 illus.

The Elements of 'Celestial.' Lt. Comdr. P. V. H. Weems. Basic equipment needed for celestial navigation is listed and information for its use is outlined. The list includes the following: (a) aircraft sextant, Link averaging type; (b) accurate watch, preferably with second-setting feature; (c) *Air Almanac;* (d) *H. O. 214;* (e) *Line of Position Book;* (f) *Star Altitude Curves;* (g) *Navigation Note Book and Plotter;* and (h) *Illyne Star Chart. Flying*, February, 1944, pages 34, 99, 1 illus.

Business and Finance

How Tax Policies Affect Our Industry's Future. H. L. Federman. Claiming that the documents mentioned reveal the official Administration attitude toward possible revision of renegotiation procedures and the establishment of postwar reserves, the writer analyzes sections from three Government reports as a guide for the aircraft industry in suggesting where corrective action should be directed. It is his contention that, instead of trying to correct the renegotiation processes, it would be far more desirable and effective to concentrate on the tax elements, because even if earnings were not reduced by renegotiation, a substantial portion would be recaptured by excess-profits taxes. He explains, too, that the direct tax approach would not only center control and regulation of earnings in one Government agency, the Treasury Department, but would also be more efficient and economical.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

The three reports consist of a special study on "business deposits" by the Federal Reserve Board, a S.E.C. survey on corporate war and postwar reserves, and *Postwar Expenses Related to Wartime Incomes* issued by the Tax Research Division of the Treasury Department. The writer records the larger earnings of leading American industrials for the four-year period of 1939–1942 as compared with those of representative aircraft companies. He also points out that the aircraft industry's problem of a return to peacetime economy is a much greater one than those of the industries possessing the "business deposits" and "reserves" highlighted by the Government surveys.

The various elements considered by the Treasury Department in its tax discussion as proper charges to wartime income and those types of expenditures for which postwar reserves may be provided are reviewed. In the latter group are included dismissal payments, abnormal maintenance expenditures, reconversion costs, losses resulting from cancellation of war contracts, and inventory losses caused by declines in prices. A discussion of the carry-back provisions of the tax law is outlined. *Aviation*, January, 1944, pages 190, 193, 334.

Population Tides Shape Airline Future. Roger Wilco. The manner in which population shifts will affect the operations and earnings of air lines in the future is surveyed. Comparisons are drawn with the history of the railroads under the influence of changes in population density in accordance with industrial developments. An analysis of population trends, made by the Assistant Director of the Bureau of the Census and based on data gathered in connection with the registration for ration books, is referred to. Comments are offered on the probable effects of changes in population caused by the war industries and the permanent distribution that may be expected after the war. Various cities are classified into groups according to the rate of population growth during the war and in earlier year. *Air Transport*, January, 1944, pages 98, 100, 103, 104, 1 illus.

Beam of Sunshine Pierces Termination Clouds. Raymond L. Hoadley. Following congratulatory comments upon the appointment of Bernard Baruch as head of the postwar reconversion program, the writer indicates why he believes this appointment will aid the aviation industry in the orderly and speedy termination of war contracts. He also outlines the responsibilities of the aircraft manufacturers in bringing about well-regulated reconversion. One of the more specific predictions made with regard to Baruch's lines of action is the rejection of Comptroller General Warren's proposal to have his General Accounting Office pass on all terminations.

War contractors are advised to set up certain controversial costs in their accounts until such a time when policies regarding these costs are regulated. Strict adherence to established production controls and procedures on excess inventories is suggested. *Aviation*, January, 1944, pages 122, 123, 333, 334, 1 illus.

Camouflage

Sleight-of-Hand Men of the Air Force. An account is given of how men of the Engineer Aviation Camouflage Battalion are being trained at an airfield in Arizona not only to capture airfields but to camouflage them so that they are concealed from enemy reconnaissance planes. It is noted that almost every man in the battalion has been a specialist in civilian life. They include artists, visual education instructors, sculptors, architectural draftsmen, and various kinds of technicians. Illustrations show how captured airfields are camouflaged. *Popular Mechanics*, February, 1944, pages 40–45, 10 illus.

Civil Aviation

Speculations on Airworthiness and Operating Regulations. Edward Warner. The Vice-Chairman of the Civil Aeronautics Board states that now is the time for proposing changes in civil aviation regulations, especially fundamental ones, if they are found desirable. Discussing the establishment of rational relationships between design requirements and operating conditions, he states that the general trend away from arbitrary methods of airworthiness regulations which has taken place during the past 20 years will probably continue. He considers the question of whether design and operating requirements should be so interwoven that no

They wouldn't fly without them...

Blue baby shoes always hang on the steering column of a famous bomber, whose pilot regards them as his "holy of holies" and refuses to fly without them.

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aircraft can ever be used in an unsafe fashion without violating a regulation, or whether the user can be relied on to keep within the limits of safe practice. The C.A.B. would then concentrate on getting the information that will enable the user to decide what safe practice is.

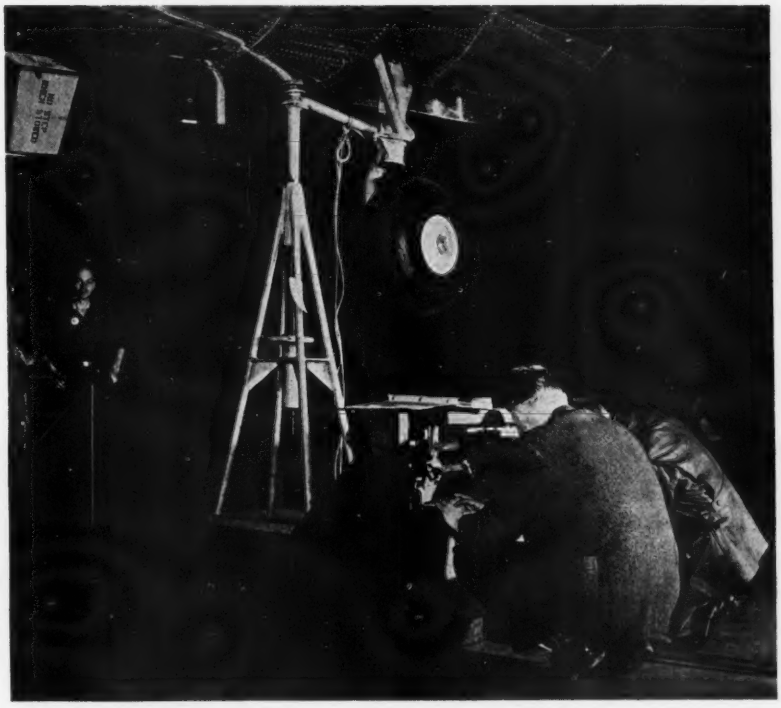
It is believed the proper scope of future equipment regulation should be framed: (1) to prevent the manufacture and sale of aircraft presenting an inherent and inevitable hazard; (2) to insure that the purchasers of aircraft will receive adequate and accurate information on characteristics important for safety; (3) to require, in cases especially pertinent to the public interest, that the conditions under which equipment is used should be so related to the equipment's characteristics as to maintain proper margins of safety. *S.A.E. Journal*, February, 1944, pages 37-48, 4 illus. (Transactions.)

Design

Where Should Weight Reduction End? Andrew T. Court. The establishment of approximate figures representing the maximum admissible additional production cost for every extra unit of airplane weight saved is advocated. It is shown that the creation of such standards, varying with each plane, could effectively direct more attention to the weight-saving problem, without interfering with any of the major operations of design and production, and enable designers to judge with some degree of accuracy whether any proposed weight-saving is worth while. To prove the necessity of such criteria, several minor components that could safely be reduced in weight are listed, while it is pointed out that such reductions are not effected because of the difficulty of determining whether the resultant cost in machine time and material requirements justify them.

For a typical medium bomber the mimimum value of weight-saving is set at $1.50 per ounce. An analysis of published data on the original North American B-25 explains the derivation of this figure. In considering what has already been done toward the weight reduction of aircraft components, it is reported that fairly detailed attention has been given to minimizing the weights of engines and propellers but that accessory and equipment designers have lagged behind in this respect. *Aero Digest*, January 15, 1944, pages 84, 86, 231, 232, 235, 2 illus.

"Where Angels Fear . . . ." C. A. H. Pollitt. A critical review of the Saunders Roe report, which stressed the value of the flying boat. Two major objections are raised to the advantages claimed for this type of aircraft: (1) The flying boat can only provide coast-to-coast transport, thus only performing part of the job; (2) the ton-mileage loss of pay load, caused by sacrificing internal space to an arrangement of steps and chines, may be sufficient to turn the scales in favor of the landplane. Suggestions are offered for modifications of the floating dock featured in the report to render it more suitable for the maintenance and overhaul of future power plants and to eliminate the need for carrying engine-maintenance platforms as auxiliary equipment. Because it is claimed that the Saro report created the false impression that the development of flying-boat design has progressed further in the United States than in Britain, the commentary also includes testimony concerning civil flying-boat design, defending the quality of British civil flying-boat design. *Flight*, December 16, 1944, pages 661, 662, 2 illus.



To determine whether the center of gravity falls within the prescribed limits, every one-hundredth Flying Fortress bomber is weighed. The operation requires three scales—two under the wings and the third just ahead of the rear landing wheel.

Designing for Production. Part IX. James E. Thompson. The ninth section of a continued article about designing aircraft to facilitate production is concerned with the forming of sheet-metal parts. It explains the tendency of metal known as "spring back" and the part it plays in bending operations, stating that it is of less importance in forming. The metalworking machines principally used in forming sheet-metal parts for aircraft are listed as power rolls, hydropresses, drop hammers, and mechanical presses. The operation and the types of work performed by power rolls and hydropresses are covered in considerable detail. The four kinds of forming dies and blocks used with the hydropress are made of steel, cast zinc, wood composition, and plastic, and the specific application of each of these is discussed. It is noted that, although the hydropress is flexible, it has certain limitations imposed by the physical characteristics of the material being formed, and suggestions are made for planning the work in such a way as to obtain the greatest benefits from the capabilities of the machine. *Western Flying*, January, 1944, pages 52, 54, 56, 58, 8 illus.

Graphical Aids for Designer and Draftsman. Part 2. Harold C. Martin. In the second part of a two-part article the development of charts for the design of riveted connections is discussed. Common types of riveted joints are illustrated and described, and three primary causes of failure are listed. Observing that there are only one or two basic differences between each of the joints selected, the writer comments on the characteristics of each and works out the basic equations for developing the design chart, using specific problems and giving the solutions. It is indicated that the methods explained will often greatly simplify the work of designing for proper strength and that similar problems can be reduced to sets of design charts, saving time and effort for the engineer. Charts for the determination of tension, shear, and bearing of rivets for design reference are reproduced. *Aero Digest*, January 1, 1944, pages 101, 102, 142, 144, 2 illus.

"Uniframe" Construction. L. R. Morphew. As an answer to the problem of producing a few aircraft at a price comparable with the production of thousands, the idea of "uniframe" construction is offered. Essentially, this consists of designing an airplane so that the main frame of its fuselage can be built up from standard pieces by cutting them in different lengths and fitting them together with standard

When something seems rotten in Denmark...

THERE is a strange quality in us all—even in fact-minded engineers. We tend to suspect ourselves first when we're face to face with failure. We forget that human beings have no corner on error.

Behind an apparent failure, for instance, may be the innocent face of a meter that failed to tell the truth. From there, calculations went hopeless awry and ended in a wad of paper held in an angry fist.

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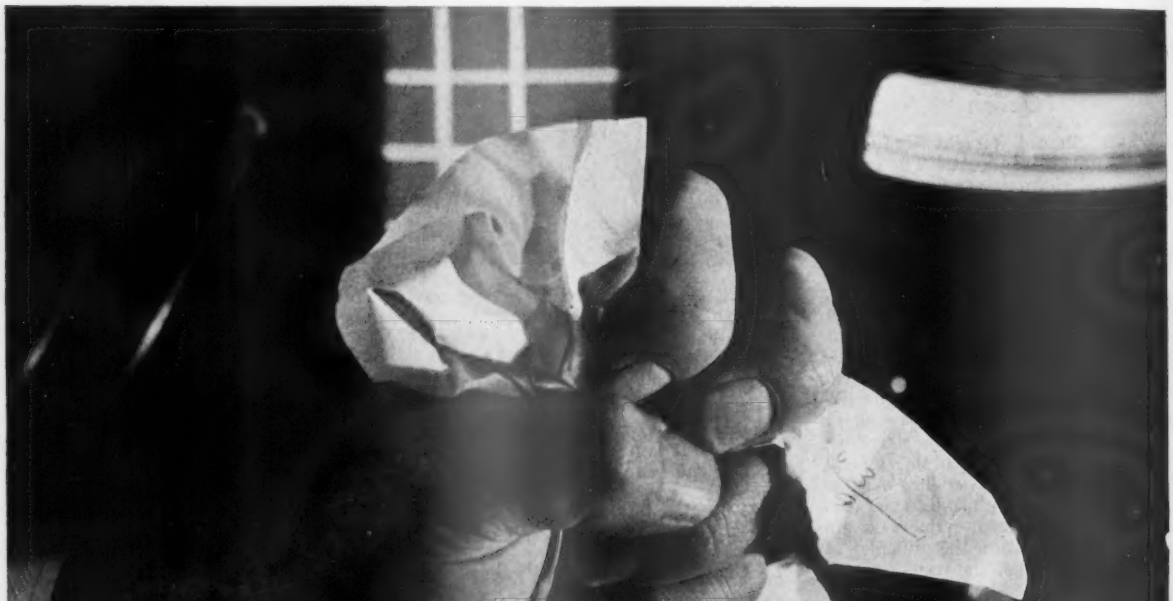

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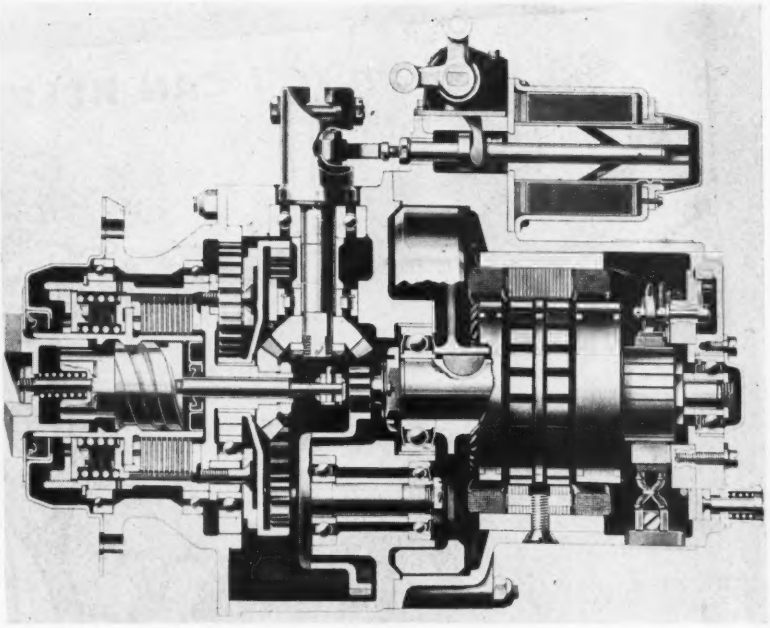
joints. The suggestion is illustrated by diagrams showing typical shapes obtained from combinations of the type of "uniframe" and others depicting the application of the principle to a complete fuselage using four unit frames. *The Aeroplane*, December 24, 1943, page 735, 4 illus.

Weight Control in Specification Writing. Part 2. John E. Ayers, Jr. In the second part of an article on the preparation of aircraft specifications in such a way as to effect weight economy, it is stated that numerous opportunities exist for reducing weight without entailing risks of failure. It is also stated that there are certain factors in practical operation that make unnecessary the provision of strength and weight enough to meet the extreme conditions frequently incorporated in the structural design. For example, allowance can be made for the expenditure of fuel or bomb loads or for jettisoning expendable loads in emergency so that landing gear need not be designed for the maximum gross weight; provision need not be made for jacking or lifting a fully loaded plane; aerodynamic computations for maximum gust acceleration can allow for partial expenditure of fuel loads before critical weather conditions are likely to be encountered; and many of the components, accessories, fittings, and other parts can be lightened. Among the dimensional features listed as contributing toward weight economy are thick airfoil sections, small wing area, high taper ratio, optimum rib and spar spacing and location, low aspect ratio, high thickness ratio, and high aerodynamic balance.

The type of construction selected for the surfaces is another factor, listed in descending order of efficiency as geodetic, nongeodetic, monospar, twinspar, multispar, and so on. It is noted that proper selection of standard parts can effect savings in excess of 1 per cent of the weight of the airplane. Weight economies of as much as 5 per cent of the total weight of the plane can be made in the power plant and equipment, and suggestions in this category include 26 items. Simplification of design, elimination of unnecessary attachments, strict adherence to weight limits in parts, and the active participation of the weight-control engineer in preparation of specifications are urged as the means for producing an airplane as much as 15 per cent lighter than one not designed with a view toward weight economy. *Aero Digest*, January 1, 1944, pages 92, 215, 216, 219, 1 illus.

Fort vs. Lib. Peter G. Masefield. The writer compares, in the heavy day-bomber category, the late model of the Consolidated Liberator with the most recent version of the Flying Fortress. The respective merits of the B-24J and B-17G are considered on points of defense, load and range, speed, flying qualities, vulnerability, and maintenance. *Flying*, February, 1944, pages, 49, 168, 2 illus.



A cutaway view of the Eclipse "Series 43" inertia and direct-cranking electric aviation-engine starter. The starter provides an initial cranking speed of 110 r.p.m., followed by direct cranking to aircraft engines having piston displacements of approximately 670–1860 cu.in.

Electrical Equipment

Aircraft Signal Systems. Raymond A. Rugge. To provide the pilot with dependable warnings of dangerous conditions, this paper proposes that aircraft signal devices be designed and installed in compliance with the pilot's requirements as expressed in three design principles. The paper describes what the writer regards as the weaknesses of current signal devices; it recommends signal light indicators that are bright enough to be seen under direct sunlight; and it illustrates and describes an automatic dimming control that operates as a function of natural light, independent of pilot actions. *Electrical Engineering*, January, 1944, pages 3–5 (Transactions), 3 illus.

Designers Meeting Need for Lighter Electrical Equipment. James F. Carland. Commenting on the growing size and complexity of the electrical equipment for the present-day large airplane, the writer confines himself to a discussion of control equipment necessary for the full and convenient utilization of electrical power in aircraft motor drives. Lightweight and compact control devices mounted in convenient enclosures for easy installation and connection are shown to have many advantages in facilitating the assembly of the airplane and maintaining it in service. Descriptions are given of such apparatus for the control of fuel-pump motors, engine-starter motors, and other applications, accompanied by wiring diagrams and illustrations showing their small size. Other motor-operated aircraft components for which control devices are described include propellers, landing flaps, antenna reels, bomb hoists, and wing-folding mechanisms, for all of which detailed electrical explanations are given. *Aero Digest*, January 15, 1944, pages 99, 100, 103, 214, 217, 11 illus.

Engines

Motion Analysis by Means of High-Speed Photography. H. D. Jackes. In analyzing the operation of aircraft-engine parts the high-speed motion picture camera has many advantages over the older methods, which involved the use of vibration indicators, stroboscopes, and strain gauges. It is shown that high-speed motion picture studies have the advantages of forming a permanent record and of accurately evaluating transient conditions. Some of the many subjects that have been studied by means of high-speed motion pictures are illustrated and discussed. *S.A.E. Journal*, February, 1944, pages 49–53 (Transactions), 16 illus.

Lancaster I and II. Advantages of interchangeable "power eggs" are reviewed, with the system exemplified by its application to the Lancaster four-engined bomber. In the case of the Lancaster I being changed to the Lancaster II by fitting a Bristol Hercules XVI engine in place of a Rolls-Royce Merlin XX, it is reported that a change in the design of the engine mounting was the only structural alteration. Emphasis is placed upon the fact that the interchangeability applies to both liquid- and air-cooled engines. The article also lists the specifications for both the Merlin XX and the Hercules XVI engines. *Flight*, December 9, 1943, pages 634–637, 12 illus.

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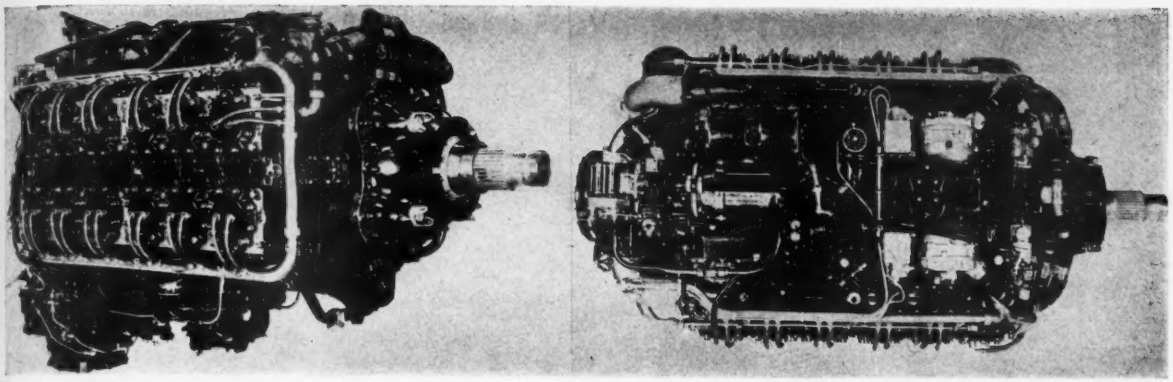
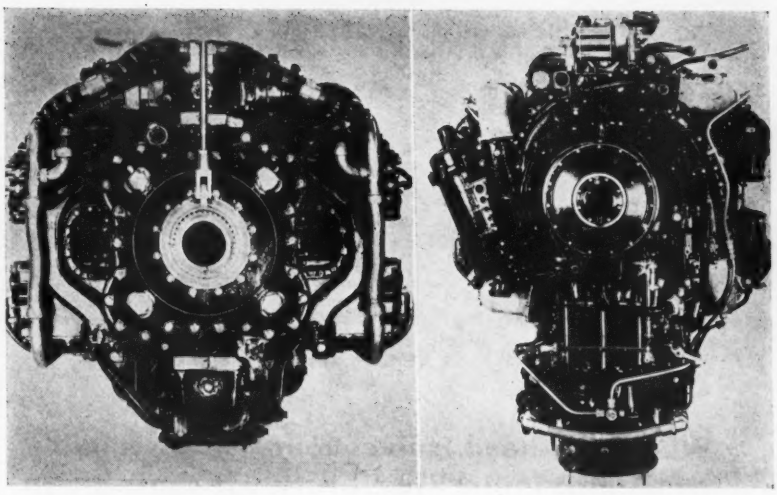




Four views of the Napier Sabre 24-cylinder, liquid-cooled, sleeve-valve engine.

Supercharged Ignition Cures "Rough Engine." Following an analysis of the causes of deterioration in the ignition harness for aircraft engines, including an explanation of the chemical action that affects the insulation, the disadvantage of the usual remedies are outlined. A description is then given of what is called a supercharged ignition distribution system that not only supplies pure, dry air to the sealed space between the wiring and shielding at a pressure higher than the surrounding atmosphere but also provides means for removing the contaminated air before it has had time to cause damage. The construction and operation of the device are explained in detail with the aid of a schematic diagram.

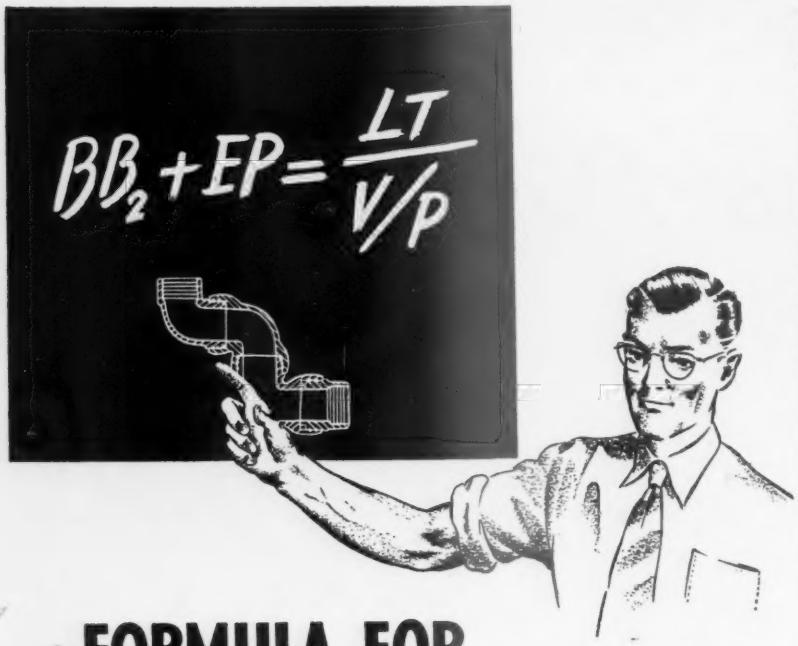
In addition to the advantages of increased dependability in the ignition system, it is stated that economy in maintenance is effected, since the wiring has been found suitable for longer service before replacement. Laboratory tests are described in which the entire ignition manifold, leads, and spark plugs were operated under water, followed by the purposeful admission of water to the assembly and a further run, proving that the circulation of dry air, even when unaccompanied by engine heat, was capable of removing more moisture than would be present during operating conditions. A comparative flight test with a twin-engined transport through unfavorable weather showed that the system was free of impurities after 500 hours, whereas the harness of the other engine, not equipped with the system, had to be drained and dried after 250 hours. It is further stated that the entire fleet of DC-3's of Northwest Airlines, fitted with the harness, has accomplished over 5,000,000 engine-miles of flying without a single case of trouble from contamination or moisture. *Aviation*, January, 1944, pages 209–211, 359, 5 illus.

Engine Cowlings. Prepared by the British Ministry of Aircraft Production, these notes describe the arrangement of the engine cowlings of the Me 109F, Do 217, and FW 190. It is reported that the cowlings in these three German aircraft appear to be designed to facilitate rapid removal and replacement of the power eggs and to afford the cleanest possible form for the assembled plant. Each cowling is attached directly to the engine and not to the fuselage, so that the engine can be removed complete with its cowling. This arrangement is said to enable the engine to vibrate on its rubber mountings relative to the fuselage without any risk of distortion to the cowling. In the case of the Me 109F, powered by a D.B. 610E, twelve-cylinder, inverted-V liquid-cooled engine, attention is called to the vibrational freedom of the engine and to the toggle fasteners that secure the "bonnet" to the top of the exhaust-manifold shroud. In the case of the Do 217, powered by two B.M.W. 801A, 14-cylinder, twin-row radial engines in underslung nacelles, emphasis is placed upon the "car bonnet" practice. In the case of the FW 190, powered by a B.M.W. 801D, 14-cylinder, twin-row radial engine with fan-assisted cooling, the armored oil reservoir is featured. *Flight*, December 16, 1943, pages 672–675, 9 illus.

Don't Count Out the Diesel. Paul K. Wilkinson. It is stated that so far during the war the United States has concentrated on high-powered gasoline engines but has neglected the development of aircraft Diesels, which may constitute the difference between success and failure in the postwar era of intensive aerial competition. Germany has not neglected the aircraft Diesel. While gasoline engines are used on fighters and bombers, Diesels are employed to a considerable extent in other planes. It is noted that the aircraft Diesel upon which the Germans pin their hopes is the Junkers Jumo 205 and its more recent derivatives such as the Jumo 207 and the Jumo 223.

The characteristics of these engines are reviewed. The most recent Diesel-engined planes in Germany about which information has been released are the Junkers Ju 86P-1 observation plane and Ju 86P-2 medium bomber, derived from the Junkers Ju 86K medium bomber. Both of these new planes are designed to function at altitudes of from 40,000 to 50,000 ft. in the substratosphere. The engines powering these new high-altitude planes are Junkers Jumo 207 Diesels equipped with gear-driven superchargers for low altitudes and with turbosuperchargers that can be cut in to give greatly increased boost and power output at high altitudes.

It is stated that the aircraft Diesel has an excellent performance at high altitudes where it is not affected by electrical ignition problems. Discussing the possibility of aerial attacks on the United States, it is noted that the Germans could make use of their new Heinkel He 177 long-range bomber



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which has a flight range of 7,500 miles. Powered with gasoline engines, it is doubtful whether this plane could carry any appreciable load of bombs, but, if powered by Diesels, the plane could carry a devastating load of bombs because the difference in the specific fuel consumption of the two types would give the Diesel-engined plane a much greater load-carrying capacity. To support this view, figures are given on the relative fuel consumption of the two types of engine and the saving in fuel load that would be realized with Diesels. Remarks are made about the postwar market for large aircraft, current plans for building them, and the work done in America with the Diesel engine. *Air Trails*, February, 1944, pages 24, 58, 60, 2 illus.

Flight Technique

Trim. Lt. (j.g.) Robert W. Duncan. Based on his experience as an instrument instructor in the Naval Aviation service, the writer makes some observations about the common errors frequently noted in the flying technique of both students and older pilots, particularly in the use of trim. He urges that trim tabs be used not as auxiliaries but as a major factor in the control of the airplane to make flying easier and more accurate. Instructions are given for the use of trim, particularly in aerobatics, and for clean, skillful flying at all times. Further comments are made concerning the amount of rudder trim, the use of trim in instrument flight, in diving or steep climbing, and in other maneuvers. The trim tabs are compared with an automatic pilot for relieving the muscular effort of flying and making the stick and rudder pedals secondary or "corrective" controls. Proper use of trim is recommended by the writer for improved flying either by contact or instruments. *Air Facts*, February, 1944, pages 54–58.

Fuels

Aviation Fuels for the Future. Jennings Randolph. In reply to the question of whether America's petroleum resources are sufficient to supply the future demand for aviation fuel and lubricants, the writer indicates methods of augmenting natural oil resources through the production of synthetic fuels and urges the support of programs for the further development of these methods. With the hydrogenation of coal featured as the most important of the processes for obtaining synthetic fuel, recent hydrogenation developments are reported to be applicable not only for the obtaining of super-octane aviation fuel but for Diesel oil and lubricants as well. Other specific uses of coal conversion products in the manufacture of airplanes and airplane materials are recorded. Figures and facts in this article are quoted from hearings conducted by the War Minerals Subcommittee of the Senate Committee on Public Lands and Surveys for the purpose of determining whether there are

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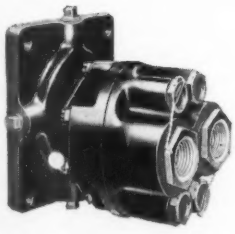

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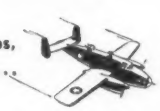

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Du Pont "Lucite" methyl methacrylate resin transmits heat slowly (at about one-fourth the rate of glass, for example, and 1/800th the rate of aluminum)

The low thermal conductivity of Du Pont "Lucite" methyl methacrylate resin is evident with a simple touch of the hand; the feeling of *warmth* is the effect of *slow* dissipation of heat from the hand . . . a low rate of heat absorption by "Lucite," in contrast to the higher rate experienced in touching glass or the much higher rate in touching metals. The thermal conductivity of "Lucite" is about one-fourth that of glass, about the same as that of rubber, and 1/800th that of aluminum.

THERMAL CONDUCTIVITY

Du Pont "Lucite" in cast sheets	Glass	Aluminum	
1.5 to 2.0	5.0 to 7.0	1300 to 1500	BTU per square foot per inch per degree F per hour
0.0005 to 0.0007	0.0017 to 0.0025	0.46 to 0.50	calories per square centimeter per centimeter per degree C per second

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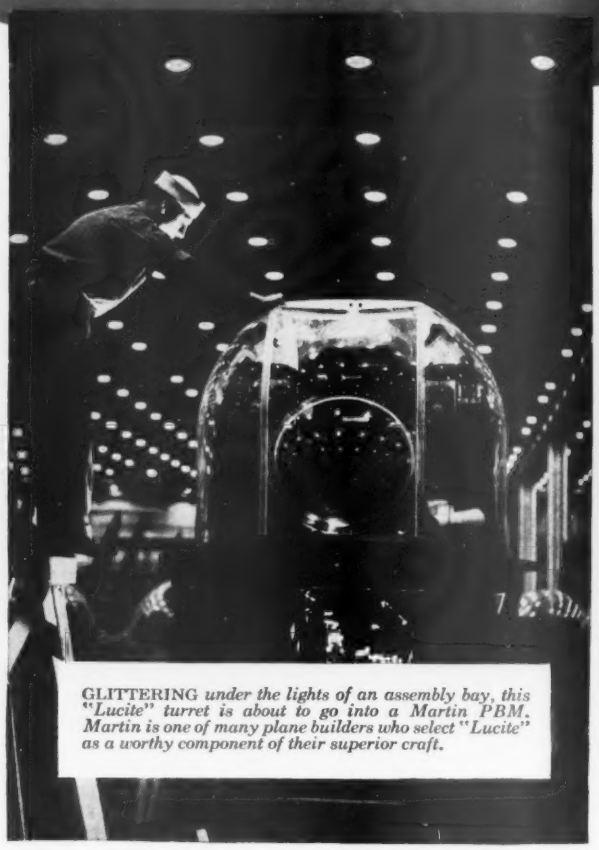

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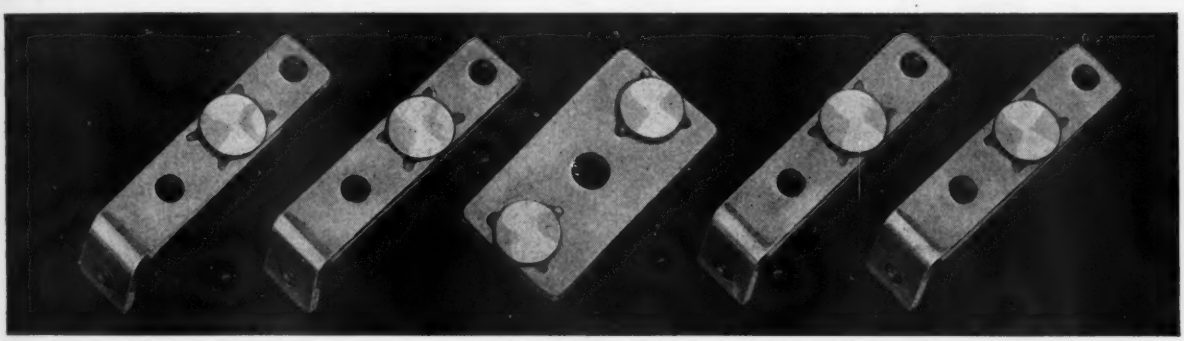

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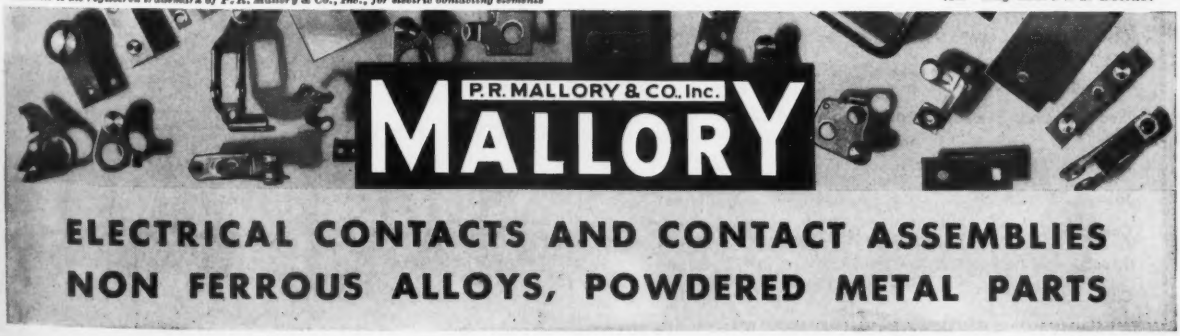

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any reasonable prospects of procuring from other sources the liquid fuel necessary for the construction and expansion of air transportation. *Aero Digest*, January 15, 1944, pages 58–60, 235, 236, 6 illus.

Butane for Aircraft. Nelson M. Jones. A study is made of the chemical structure, characteristics, action, and advantages of butane as a lightweight 100-octane engine fuel. Indicating the adaptability of liquefied petroleum gases for aircraft engines, the writer includes in his discussion a consideration of the types of containers required for butane and the type of engine that would give the most effective results with this fuel. He also explains the misconception with regard to the "freezing" characteristic of liquefied petroleum gases. Among the advantages attributed to butane are greater power, more safety, and the elimination of a warming-up period. *Flying*, February, 1944, pages 45–46, 156, 3 illus.

Gliding and Soaring

Gus Briegleb's Two-Place. A description is given of the characteristics and development of the model BG-8 two-place sailplane. The writer tells how this sailplane successfully passed static tests and was then subjected to final flight tests. It is explained that the BG-8 is of wood construction and that the wings are of the monospar type with built-up plywood ribs. Poplar plywood is used for the wing covering. The fuselage is semimonocoque with three spruce longerons and $^1/_8$- to $^3/_{32}$-in. plywood skin. The elevators and rudder are provided with controllable trim tabs accessible from either cockpit. It is stated that these trim tabs were found to be quite adequate through all speed ranges. Comments are made regarding other details of the performance of the craft. *Soaring*, July-August, 1943, pages 9, 10, 14, 3 illus.

High-Altitude Flying

Up Where the Oxygen Ends. Wayne Whittaker. An article on flying at high altitudes describes physiologic reactions in the substratosphere, high-altitude flying equipment, and the features of aircraft designed for flight in the substratosphere. The writer tells how some of the problems of this type of flying are being overcome. The preparations of Army aviators for high-altitude flights are described. *Popular Mechanics*, February, 1944, pages 8–11, 156, 158, 10 illus.

History

Aeronautics in 1943. The first of a series of articles in which aeronautical developments during 1943 are reviewed. The technical progress in military aeronautics is traced. It is stated to be fairly certain that the war will be won, so far as the air is concerned, principally with the aid of aircraft conceived before 1939 and progressively improved since then. Several examples of this process of aircraft adaptation and improvement are mentioned, including the Lancaster, Spitfire, Mosquito, and the Mitchell. It is stated that during the war Germany has produced only one design of aircraft which can reasonably be described as new. This is the Heinkel 177 large bomber.

Reference is made to new aircraft known to be under construction in the United States. The future of jet propulsion is discussed. It is explained that the efficiency of jet propulsion increases markedly with the speed and that at low speeds the efficiency will probably be found too poor to permit the system seriously to challenge orthodox propeller propulsion. *The Engineer*, January 7, 1944, pages 6, 7, 2 illus.

Early Developments. Capt. Norman Macmillan. A short historical outline is given of the British aeronautical industry from 1898 up to 1916. It is noted that the actual industrial development started during 1909–1910. *Aeronautics*, January, 1944, pages 49, 50.

Hydraulics

Pressure Control in Aircraft Hydraulic Systems. Part I. Edward M. Greer and Lt. Comdr. Harry J. Marx. Relief valves are considered in the first of a series of articles about the problems of control and various control devices for aircraft hydraulic equipment. After naming the causes of unequal action of the hydraulic devices used on prewar commercial aircraft and showing that such inequalities are not of vital importance for that type of service, the greater need for accurate control in military planes is indicated by the higher speeds and more complicated mechanism employed. Foremost among the changes wrought by the expanding demands upon the hydraulic system is the higher pressure now required. Present military aircraft systems operate at 1,350 to 1,500 lbs. per sq.in., with at least one instance of 3,000 lbs., and a trend toward the higher pressure is stated to indicate that within a year or two all systems in new aircraft will operate at 2,000 to 3,000 lbs. per sq.in.

Pressure-control devices are classified into the following groups: (1) relief valves, (2) pressure-regulator valves, (3) variable-displacement or self-regulating pumps. (4) hydraulic power valves, and (5) hydraulic boosters and deboosters. The relief valve is defined and its construction and operation are explained at considerable length, with information about the specifications developed after extensive research and improvements that have been made in design. It is stated that the principal function of the relief valve now is as a safety valve in case the pressure regulator fails. Its placing in the system is discussed, and detailed descriptions are given of two types of relief valve. *Aviation*, January, 1944, pages 169, 171, 172, 360, 6 illus.

Icing

Ice. Robert N. Buck. Stressing the importance of two rules for flying during conditions when ice forms on an airplane, the writer gives advice on the effects of ice and how to overcome them. The two rules are: "When ice first begins to form, do something about it," and "never attempt to fly any icing conditions without the proper equipment." Concerning the first rule, the recommended action is to get away from the ice-forming region by climbing above it or descending below it, but action must be taken quickly because ice can form in a short time. The different degrees of icing are defined, with comments on what happens to the wings, propeller blades, fin, stabilizer, and other parts when ice coats them, as well as the effects on the plane's performance. The action of various types of deicing equipment is explained, particularly how the deicer boots should be operated. Instructions are given for landing the plane when it is partially coated with ice. *Air Facts*, February, 1944, pages 25–32, 3 illus.

Inspection

Magnetic and Electrical Inspection. R. R. Moore. The Chief Metallurgist of the Naval Aircraft Factory, Philadelphia, discusses the development of nondestructive methods of testing important and critical metals. He describes the advantages of methods based on magnetic and electrical principles. *Metals and Alloys*, January, 1944, pages 110, 111, 1 illus.

Special-Purpose X-Ray Equipment. A description is given of a new unit, designed by the Victor X-ray Corporation, Ltd., for the radiographic examination of copper-lead cylindrical bearings of engines.

Two methods of inspection are employed, and the fixture with the necessary accessories may be used for either of these methods. The first consists of radiographing the bearing in six exposures, including 60° of the total circumference in each, and the second comprises radiographing the entire circumference at a single exposure. Both methods of inspection are described. *Aircraft Production*, January, 1944, pages 42, 43, 3 illus.

X-Rays in the Light Alloy Foundry. F. R. Mansfield. A British radiologist describes the practical application of routine radiography for the development of sound casting methods and production control. Plant requirements are outlined and techniques are explained. He discusses the interpretation of radiographs and their evaluation. The article has particular reference to the production of high-strength aluminum castings for aircraft. *Light Metals*, October, 1943, pages 469–478, 8 illus.

Alteration of X-ray Beams to Meet Inspection Requirements. Robert Taylor. After an explanation of the functions of a filter in altering the

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quality of a beam of X-rays, the effect of the filter is further clarified by a description of the X-ray inspection of a casting having thicknesses varying from $^1/_4$ to 1 in. The filter and its characteristics are defined, and the relative properties of copper and aluminum filters are discussed, with remarks about the placing of the filter, the tube, the film, and the casting that is being inspected. The effects of scattering are explored, and it is shown that the full absorption curve is the best means of measuring the degree of penetrative power. Other methods of expressing degree of "hardness" are mentioned, with comments on their advantages. Instructions are given for the determination of the effective wave length and the proper filter thickness. The article closes with comments on the modifications needed when using filters made of metals other than copper or aluminum. The conclusion is reached that the range of steel sections in which filtered radiation shows an improvement is from $^1/_2$ to 2 in., while, above that, thickness absorption takes place within the steel to the extent that no advantage is derived from the use of filters. This does not hold true for the light alloys, in which the use of filters for sections of 1 in. and greater thickness shows an improvement over unfiltered radiation. *Aero Digest*, January 15, 1944, pages 114, 116, 206, 209, 6 illus.

Instruments

High-speed Multiple-point Recording of Thermocouple Temperatures During Flight Tests of Planes. I. Melville Stein, Albert J. Williams, Jr., and Wm. Russell Clark. An outline is given of the requirements for an instrument for measuring exhaust gas temperatures in the flight testing of large airplanes. The characteristics of the instrument developed are described, as well as its recording range, accuracy, and sensitivity. Push-button operation is used. *Instruments*, January, 1944, pages 26–28, 5 illus.

A Case for Standardisation. Joseph Lowrey. Showing the need for such an instrument, the writer suggests a standardized unit of manifold-pressure measurement to replace the boost gauge. He depicts by a table the confusion caused by the differing systems of boost-gauge calibration used by the British and Americans and explains why the American method of manifold-pressure measurement is the more accurate one. However, he believes that the adoption of this system for international use would require certain adjustments, particularly with regard to the units of measurement. He therefore proposes and describes the "centibar"—a manifold-pressure gauge employing a suitable multiple of the "dyne per square centimeter." *Flight*, December, 1943, pages 619, 620, 3 illus.

A Thermal Anemometer for Low Velocity Flow. R. A. Seban, W. H. Hillendahl, E. J. Gallagher, and A. L. London. This paper describes a thermal anemometer for low-velocity flow which indicates air velocities in terms of the cooling rate of a heated sphere. The calibration given reveals an adequate consistency for velocities from 15 to 3,000 ft. per min. Beyond 100 ft. per min., free-convection effects become small and the instrument indication is substantially nondirectional because of its spherical form. Operation with transient conditions enables the use of small temperature differences so that free-convection effects may be made small. Further, heater input need not be controlled or metered, as is necessary with steady-state thermal anemometers. *Transactions of the A.S.M.E.*, November, 1943, pages 843–846, 7 illus.

Gyroscopic Instrument Maintenance. Edward A. Diefenbach. Establishing the premise that all flight is "attitude" flight, whether by contact or by instrument, the writer contrasts the two methods and shows that a time lag takes place in the operation of all but one of the usual flight instruments. The altimeter, air-speed indicator, rate-of-climb indicator, directional gyro, and turn indicator all reveal attitude with some lag because of the inertia of the airplane and actually record the results of attitude rather than the attitude itself. It is stated that the artificial horizon is the only instrument in the cockpit that instantly reveals attitude.

For these reasons the artificial horizon is regarded as of such importance as to make mandatory a knowledge by all pilots of the proper care and maintenance procedure for the instrument. The construction and operation of the in strument are briefly explained in nontechnical terms, and two common sources of trouble are shown to be incorrect vacuum and a dirty filter. Suggestions are made for avoiding these troubles, which for practical purposes are the only ones likely to arise other than mechanical failure within the instrument.

The article is principally concerned with such mechanical failures because they are stated to be caused by improper care on the part of the pilot. Emphasis is placed on the necessity for observance of the manufacturer's instructions concerning caging and uncaging the gyro instruments. A lesson is taught by means of a hypothetical flight during which the limitations of the instruments are explained and the instructions are summarized. *Air Facts*, February, 1944, pages 48–52.

How Aircraft Instruments Work. James L. H. Peck. This is an elementary description of the various instruments used on aircraft and how they operate. The article is written in easily understood language and contains schematic drawings showing the mechanisms of different types of aircraft instruments. For descriptive purposes, these instruments are divided into the "rate group," which includes the turn-and-bank indicator, the air-speed indicator, and the rate-of-climb indicator; the "amount group," which covers altimeters, compasses, the artificial horizon, and the directional gyro indicator; and "engine instruments," which include the tachometer and temperature and pressure gauges. A photograph shows the instrument panel of the Curtiss C-46 Commando. *Popular Science*, March, 1944, pages 116–123, 192, 27 illus.

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Jet Propulsion

Whittle Systems of Jet Propulsion. A description is given of jet-propulsion systems that have been developed by Frank Whittle. The information is taken from an article published in *Flugsport* early in 1939, a translation of which later appeared in *Aircraft Engineering*. It is noted that the jet-propelled fighter planes now being built in the United States by Bell Aircraft Corporation and in England by Gloster Aircraft Company, Ltd., according to a joint statement on January 6 by the U.S. Army Air Forces and the British Royal Air Force, are powered by a jet-propulsion system originated by Whittle. An exhaust jet for driving a gas-turbine compressor, designed in 1935, is also illustrated and described.

A complete thermal jet-propulsion system, plans for which were given in the same year, is described. Other sections of the article cover the 1936 Whittle twin propulsion system, a two-stage compressor for a twin propulsion system, and a jet-propulsion power plant incorporating a gas turbine and reciprocating engine. *Automotive and Aviation Industries*, January 15, 1944, pages 42, 108, 110, 6 illus.

Rocket Research. J. J. Smith, assisted by J. Dennis. Reference is made to a flying model of 4-ft. wing span made by a Glasgow schoolboy in 1920, which covered 3 miles in 1 min. This achievement went almost unnoticed, as did the rocket power plant. An illustration of this model, which had a steel-cased rocket and flame-baffle tube, is shown.

An account is given of rocket experiments carried out in Scotland from about 1934 to 1939 and the results obtained. Types of jet propulsion and problems of rocket design are discussed. Some information is given about the ejector used to help the Tiger Moth into the air. The construction and control of rocket-propelled self-launching models are described. It is stated that for the amateur experimenter one advantage of rocket research is that the apparatus is simple to make. Sectional views of experimental rockets are shown, and one of these reveals the design of the Aldred rocket, which had a metal body strong enough to withstand a pressure of 300 lbs. per sq.in. in the 4-oz.-per-sec. size and a body length of 13 in. *Flight*, December 2, 1943, pages 610-613, 4 illus.; "The Rise of the Rocket," G. Edward Pendray and Jacques Martial, *Collier's*, January 22, 1944, pages 16, 17, 44, 5 illus.

Jet Propulsion from Fancy to Fact. Part I. Willy Ley. The first section of a two-part article reviews the work done in the development of rockets as applied to the propulsion of aircraft and the efforts made to utilize steam as a means of jet propulsion. It traces early attempts by British, French, and Russian engineers to utilize the reaction principle and describes the mechanisms suggested by them. How a rocket engine operates is explained, and its action is compared

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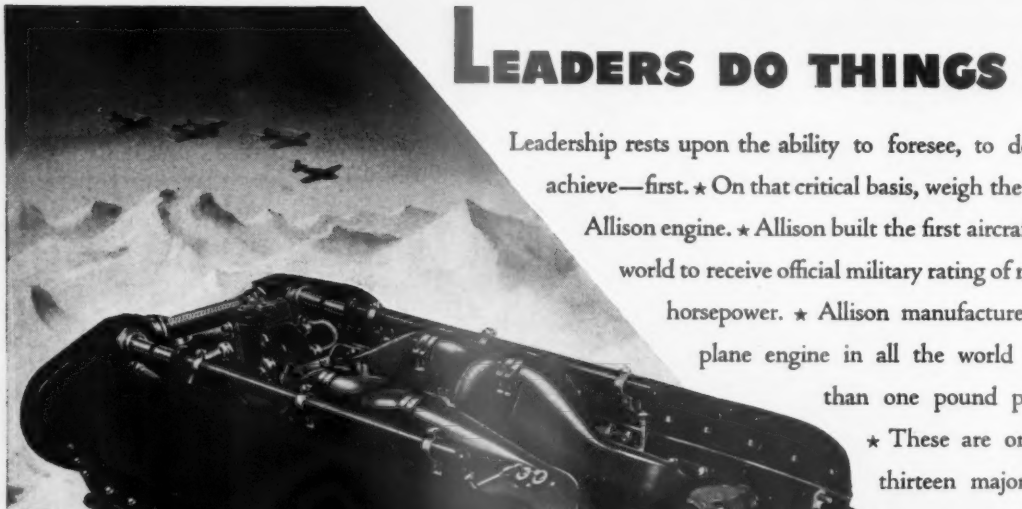

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with that of the engine and propeller combination. The writer mentions the work of German scientists with rocket propulsion in 1928 and 1929 and of Italians in the succeeding years. He outlines the results of these experiments and the records established. *Aviation*, January, 1944, pages 147–149, 309–311, 313, 6 illus.

Initial Success of Jet Propulsion Opens Wide Field in War, Civil Use. Based on an announcement released jointly by the American and British air forces, information of a general nature is given about the jet-propulsion aircraft on which experimental work has recently been completed. It gives a brief review of the history of the principle of jet propulsion and states that a craft of this type, produced by Bell Aircraft and powered by a twin-engined jet-propulsion unit built by General Electric, completed its test flights as a combat craft. The appearance and operating characteristics of the craft are described, as well as the test flights and the work recently done in England along similar lines. It is stated that the craft built by Bell made the first flight of a jet-propelled aircraft in the United States and the first in the world by a twin-engined combat craft using that principle. Other jet-propelled projects for other types and purposes also are under way. No technical information is given about the power plant, which was built from the British Whittle design. *Aviation News*, January 17, 1944, pages 7–9, 4 illus.

Motor Actuated Fuel Feeds. Cedric Giles. Three methods of feeding the propellants into the rocket power unit are defined, and detailed information is given about the third method. The first procedure employs a gas pressure in the fuel tanks for force-feeding the liquids; the second uses some form of pressure pump to inject the fuels; and the third is based on the motivating energy of the rocket-engine elements to force the propellants into the firing chamber, generally with the addition of a small gas pressure. The engine-actuated fuel feeds are classified into five groups—recoil, exhaust, aspirating, chamber pressure, and centrifugal types—each of which is described. *Astronautics*, December, 1943, pages 9–12, 4 illus.

Industry Sees No Immediate Shift to Jet-Propelled Aircraft. Opinions regarding jet propulsion and its future, expressed by aeronautical engineers interviewed on the Pacific Coast, are summarized. It is stated that the engineers were generally agreed that a conservative point of view was necessary, with one of them foreseeing two years for military perfection and ten years or more for commercial feasibility. There was doubt that jet propulsion would immediately raise top speeds above 600 m.p.h., particularly because of the factor of compressibility. Opinions varied with regard to the question of whether or not skin friction at the high speeds suggested by jet propulsion will raise cabin temperatures to a critical degree. Engineers connected with the engine-building division of the industry expressed the opinion that there would be no immediate change in the work of their industry, that the ultimate utilization of jet propulsion is unpredictable, and that a number of years of development would be required to find its best application.

It is stated that information released by the War Department re-emphasized testimony by pilots who have flown the new jet-propelled airplane that the smoothness, simplicity, and evenness of power are important characteristics. *Aviation News*, January 31, 1944, page 13.

Landing Gear

German Undercarriage Design. Based largely on information supplied by the British Ministry of Aircraft Production, notes are given on a few of the undercarriage-design features of the FW 190, Do 217, Ju 88, and Me 210. *Aeronautics*, January, 1944, page 58, 1 illus.

Lighter-Than-Air

Jet Propelled Dirigible. Constantin Paul Lent. Future air travel, involving the possibilities of a rocket- or jet-propelled dirigible, is discussed. The writer gives the advantages of lighter-than-air craft and compares that type with airplanes for commercial transport. *Astronautics*, December, 1943, pages 14, 15, 1 illus.

Maintenance

Cold Weather Plane Care. Suggestions are offered for the care of aircraft during the period of dead storage for the winter season, including old methods recalled and new methods recorded for the benefit of the private owner and operator. Precautions to be taken against fire resulting from gasoline left in tanks or from waste, rags, or matches and against damage to tires, upholstery, and other parts of the plane while in storage are suggested, as well as what to do when taking a plane out of storage. Provisions for outdoor winter parking are outlined with respect to the engine, control equipment, lifting surfaces, propeller, instruments, accessories, and other components while the plane is inactive, when it is being prepared for flight, and when taking off under winter conditions. *Air Pilot and Technician*, January, 1944, pages 19, 20, 40, 4 illus.

Maintenance of EAL's Silver Fleet. H. G. Leasley. How Eastern Air Lines revised and improved its maintenance methods to better its prewar high record of plane-utilization efficiency. Faced with the problem of handling more traffic with its remaining 20 planes than had been carried with 40 planes before the war, the company raised its operating efficiency from a prewar average of 310 hours per airplane per month to an average of 11.59 hours per day in the first 7 months of 1943, an increase of approximately 2 airplane-hours per day over the prewar record. The article tells how the inspection and overhaul procedures were revised, how an improved system of keeping maintenance records was devised, and how the handling of parts and materials was bettered. It also gives credit to the various executives who accomplished these results. Charts show the distribution of mechanical personnel, monthly and daily work schedules, shop and route layouts, and plane utilization. Illustrations cover special repair and test equipment and service methods. *Air Transport*, January, 1944, pages 32–39, 15 illus.

Management

Stores and Materials Control. Francis W. Cook. The subject of efficient stores and materials control in factory organization is discussed. It is emphasized that without organized stores and materials control production must suffer from the incomplete knowledge of materials flow. *Aircraft Production*, January, 1944, pages 44–47, 6 illus.

These Mechanical Factors Make for Efficient Labor Utilization. Herbert Chase. A second article on the utilization of labor in the aircraft industry covers mechanical factors that are concerned with the efficient utilization of labor. The writer discusses the use of conveyers, automatic machining, power-operated equipment, motion studies, work simplification, good tooling, and process refinements as aids in augmenting production. A summary is given of a 25-plant survey. *Wings*, January, 1944, pages 838–841, 5 illus.

Marketing

Realism is Requisite in Appraisals of Postwar Aviation. Paul J. Frizell. After analyzing the potential development that may be expected in aircraft markets during the immediate postwar period and demonstrating the limiting factors that will cause these markets to fall short of overoptimistic predictions, the writer estimates what the demand for the industry's products will be in terms of dollars. The potentials are discussed under the broad categories of military, private, and commercial aircraft—with the sales possibilities of both helicopters and conventional light airplanes considered in the second class and domestic air transport, transoceanic carriage, and air freight the more specific subdivisions of the third classification. The combined market for military aircraft, covering the United States' participation in an international police force and sales to other countries, is estimated at about $1,200,000,000 annually; that for domestic and overseas air transport planes, excluding cargo aircraft, is estimated at $600,000,000; the postwar demand for cargo aircraft is placed at approximately $1,500,000,000; and the sale of private aircraft is expected to be about $200,000,000. It is pointed out that this combined annual figure of $3,500,000,-

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000 approximates only 10 per cent of the peak war production. It would mean a total postwar employment of from 275,000 to 300,000 people and would necessitate a resulting adjustment constituting a national problem rather than one belonging exclusively to the aircraft industry. *Aviation*, January, 1944, pages 118, 119, 329, 330, 333, 1 illus.

The Personal Plane Sales Target. John Foster, Jr. Results are reported of a survey to determine the potential postwar market for private airplanes and the type of aircraft preferred by the public. Conducted in nine eastern, midwestern, and southern cities for Parks Air College, this survey was made as a guide for selling and servicing private aircraft after the war. An analysis of the replies to questions asked by interviewers helps to reveal some of the more general misconceptions held by the public with regard to fixed-wing airplanes as well as helicopters. Definite reasons are given as to why people do or do not intend to buy either type of aircraft, and airplane features are ranked in accordance with the percentage of prospects who selected them as most desirable.

Principal conclusions of the analysis reveal that, of the 6 per cent of American people who may be considered financially sound sales prospects, 78,000 are ready to pay at least $1,500 for a fixed-wing airplane, 119,000 want to buy helicopters, and an additional 78,000 are potential aircraft customers who have not made up their minds which of the two types of aircraft they prefer. Indifference and fear precede cost as reasons for negative replies. *Aviation*, January, 1944, pages 116, 117, 364, 367, 368, 2 illus.

The Aircraft Industry and the Man in the Street. W. C. Devereux. A commentary upon the need for a scientific marketing approach in the aircraft industry. Demonstrating that former methods of selling aircraft will not suffice for the direct-to-the-consumer business that may be expected after the war for both air travel and private airplanes, the writer urges the institution of organized marketing research programs to determine "what the customer wants." While he states that individual firms should examine the details of their own markets and retain the results as useful competitive issues, on broader issues of public relations he advocates that the industry expend a joint effort in selling aviation to the individual. *The Aeroplane*, December 24, 1943, page 734.

Materials

Aluminum and Magnesium. H. E. Bakken. Accomplishments of the aluminum industry during 1943 are surveyed. Mention is made of a new process for obtaining aluminum from low-grade ores and of the production of new aluminum alloys with materially improved tensile strength, designed for immediate wartime aviation use. It is pointed out that several years of research have resulted in the application of an ingot casting method that permits the production of sound aluminum ingots of large size for conversion into large sections of aluminum sheet, plate, forgings, and extrusions. The increase in aluminum and magnesium production is discussed. Improvements in fabrication techniques are outlined. *Metals and Alloys*, January, 1944, page 72.

Experience with the Use of Magnesium in Aircraft. J. C. Mathes. Reference is made to the great increase in the production of magnesium. It is stated that the increased incentive to utilize magnesium in reducing the weight of combat aircraft has called for information that has not been covered in technical literature and handbooks. In this paper the writer makes available for general use some of the recent information about magnesium which has resulted, in many cases, from questions raised by the aircraft industry.

The specific subjects covered are availability, choice of alloys, surface treatment and painting, stress corrosion, joining methods, service experience, effect of gunfire, and primary structures. *S.A.E. Journal*, February, 1944, pages 62–66, 72 (Transactions).

Russian Aircraft Materials. As examples of successful application of wood to aircraft production and development of this technique by the Russians, details are given on three Russian "wood" fighters: the Yak-1, Mig-3, and Lagg-3. A complimentary report by the German Experimental Institute for Aeronautics with regard to the quality of the material employed in these planes is quoted. Two tables augment the article: one shows the strength characteristics of Russian birch plywood; the other gives the names and physical characteristics of the laminated and processed wood used in the aircraft mentioned. *Flight*, December 2, 1943, pages 622, 623, 1 illus.

Flameproofing Aircraft Fabrics. The principles and factors involved in the flameproofing of textiles are enumerated, as well as the materials used in the flameproofing, the methods of application, and other pertinent details. Fabrics used in aircraft interior construction are listed as including wool, mohair, cotton, rayon, and combinations of two or more of these, and their characteristics are discussed. Methods of flameproofing and the chemicals employed are described with the aid of references to publications of the National Bureau of Standards. Procedures followed in testing and the results of such tests are also explained. *Air Transport*, January, 1944, pages 90, 92, 94, 1 illus.

Magnesium and Aluminum Castings. R. E. Ward. Developments in magnesium and aluminum foundry practice during the year 1943 are reviewed. It is found that they have been gradual and that the basic principles set down have remained essentially the same. Reference is made, however, to the introduction of low-frequency induction melting in the aluminum foundry and to conditions where induction melting may prove to be satisfactory. The use of zinc-magnesium-aluminum alloys to reduce trouble from casting warpage is discussed. The movement away from open pit melting and toward crucible melting in magnesium foundries is noted. It is predicted that during 1944 improved alloys will be developed and advances made in protective surface treatments and heat-treatments. *Metals and Alloys*, January, 1944, pages 75, 76, 1 illus.

Stainless Steels—Hot and Otherwise. H. A. Campbell. Extreme conditions of operation which led to difficulties in the application of stainless steel to the exhaust system of aircraft engines are described. It is explained that aircraft exhaust systems must be designed to withstand service conditions that include severe vibrations and high temperatures from the hot exhaust gases passing along the inside of the pipes at relatively high velocities, while the outside of the pipe system may be subjected to rain and sea atmosphere. The writer states that stainless steel can be stabilized with either titanium or columbium, the cheaper and more easily worked titanium-type steel being satisfactory for most installations, although there are applications where the columbium type must be used because of its higher yield and tensile strengths. *S.A.E. Journal*, February, 1944, pages 67–72 (Transactions), 15 illus.

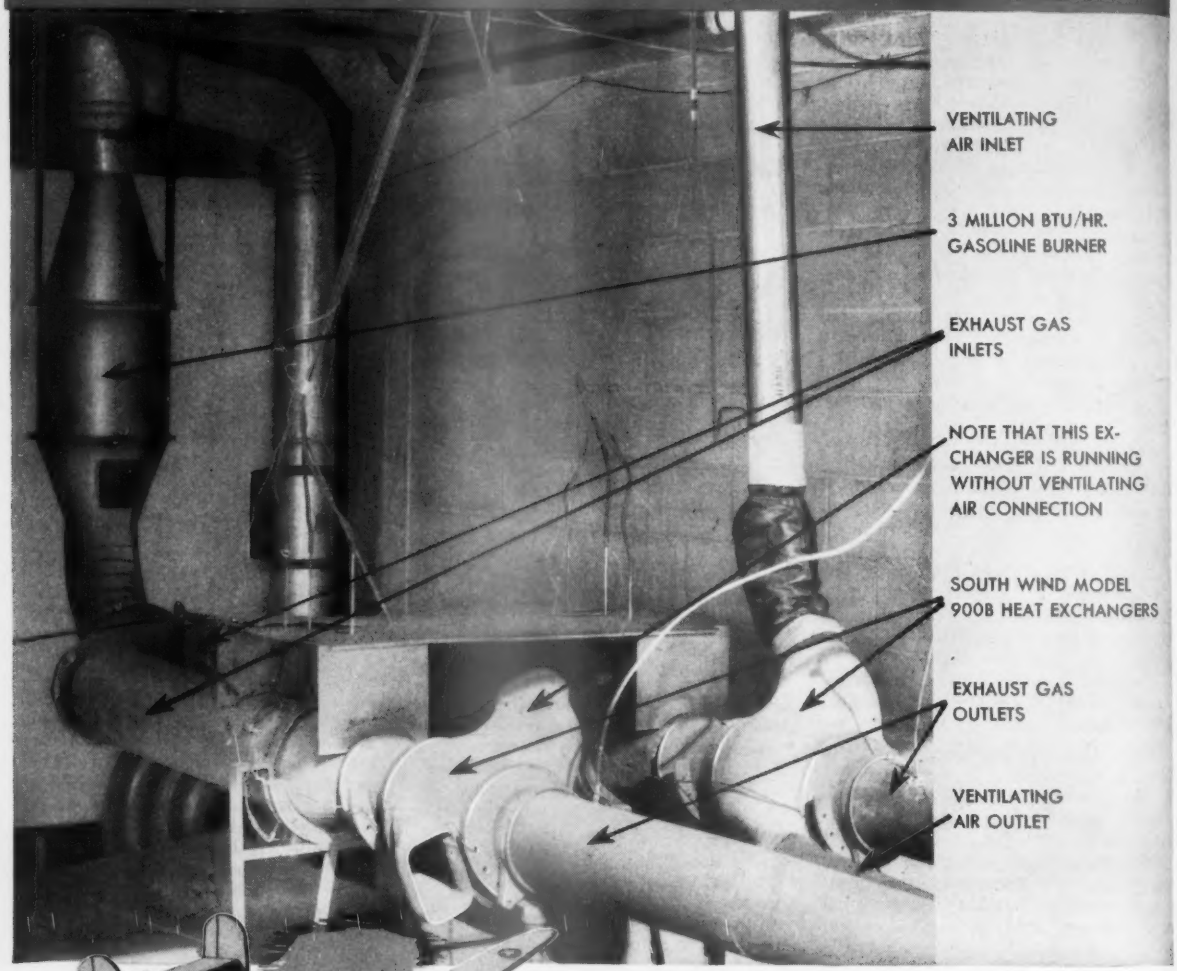
Aluminum Research Produces 25 Alloys. A brief description is given of the program conducted by the Aluminum Company of America which is stated to have resulted in the development of more than 25 aluminum alloys with special properties for a wide variety of industrial operations. It is noted that the most recent development is an alloy for aircraft use which permits a design strength 25 to 50 per cent higher than the allowable for current alloys. An estimate by the company of the distribution of aluminum in the postwar market is also given. *Automotive and Aviation Industries*, January 15, 1944, pages 33, 69, 2 illus.

Medicine

A Pursuitmeter with an Application in Aviation Medicine. Harold Lamport, Robert D. Brookes, Charles W. P. Walter, and Tracy J. Putman. Uses for the pursuitmeter, a device that measures the subject's ability to pursue a moving object with an instrument, are described.

The criteria for a pursuitmeter in aviation medicine and pilot selection are defined. An easily manufactured and inexpensive model is presented which was found to fulfill all the criteria except one, which was not evaluated. This was the important one of a good correlation between test score and flying efficiency. Lack of opportunity prevented this comparison from being made, but reasons are given why a close correspondence may be expected. No benefit was found, for the purposes of aviation medicine, in providing a graphic record of

The Heat Exchangers that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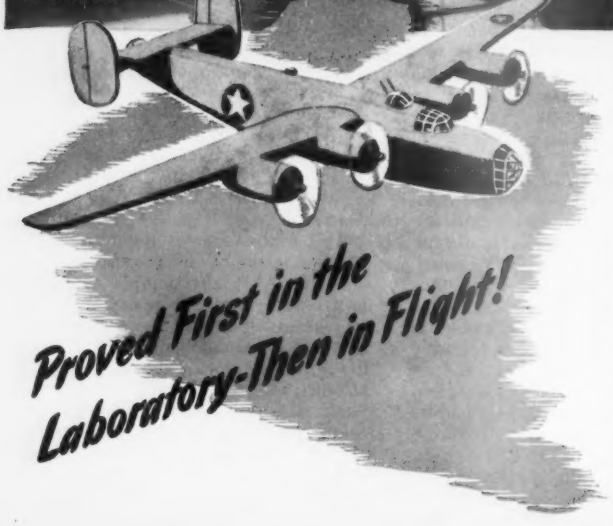

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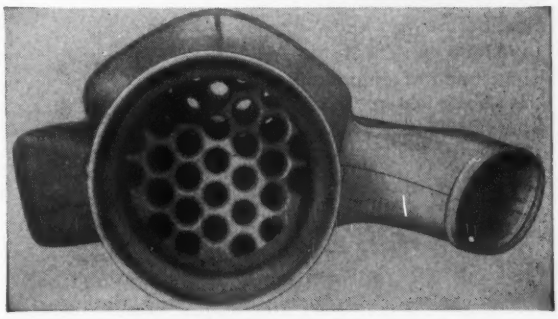

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performance as compared with a numerical index of total deviations from the target over a fixed interval of time. A simulated altitude of 15,000 ft. significantly reduced performance. Individuals were found to have fairly constant pursuitmeter scores, while they differed considerably from one another. *The Journal of Aviation Medicine*, December, 1943, pages 336–345, 7 illus.

The Effects of Pressure on the Carotid Sinus of Various Altitudes. Case Reports. Capt. Laurence Palitz, Capt. Thomas Frist, and Major Elmer Kocour. Two cases are reported which suggest that a hypersensitive carotid sinus becomes more sensitive when subjected to a lowered oxygen saturation as a result of ascent in the altitude chamber without administered oxygen. The inclusion of a simple carotid test in examinations is suggested to assist in determining which cadets should be further studied to determine the extent of their carotid sinus hypersensitivity. *The Journal of Aviation Medicine*, December, 1943, pages 346–355, 14 illus.

Flicker Fusion Tests as a Measure of Fatigue in Aviators. Comdr. Ashton Graybiel, Lt. J. L. Lilienthal, Jr., and Lt. O. Horwitz. This article reports a study of the flicker fusion test as a measure of fatigue in aviation pilots. Thirty-two subjects, all naval aviators, were used in the investigation. The results of the study are described, and the conclusion is that, in this study, the flicker fusion test offered no promise as an objective measure of fatigue in aviation. *The Journal of Aviation Medicine*, December, 1943, pages 356–359, 2 illus.

Report of a Case of Severe Anoxic Anoxia with Recovery. Capt. Robert I. Ward and Capt. O. C. Olson. What is stated to be the most severe case, with recovery, of anoxic anoxia caused by lack of oxygen at high altitude which has ever been reported in the literature is described and studied. The case is that of a 20-year-old white man who was without supplementary oxygen at high altitude for 55 min. He was unconscious for 8 hours and was semicomatose for an additional 11 hours. Findings from physical and neurologic examinations are described. Information is given regarding the psychologic changes noted. It is stated that the psychologic changes lasted about 6 days and subsequently entirely cleared up, leaving no apparent intellectual defects or personality changes. *The Journal of Aviation Medicine*, December, 1943, pages 360–365.

Airsickness in Bomber Crews. Capt. D. M. Green. The incidence and circumstances of airsickness were surveyed in 1,006 flying members of a combat bomber-crew training unit. Therapeutic and prophylactic approaches to the problem of incapacitating airsickness are described. The inadequacy of motion as a primary cause and the position of airsickness as a true aeroneurosis are discussed.

It is concluded that airsickness in the great majority of instances appears to be a true aeroneurosis, widespread in occurrence and usually self-limited. Overindulgence, infections, and antecedent tendencies to motion sickness may act as contributory factors. Repeated disabling airsickness is preventable or remediable to a significant degree. *The Journal of Aviation Medicine*, December, 1943, pages 366, 372, 1 illus.

Aeroneuroses in a Bomb Training Unit. Capt. D. M. Green. The incidence and characteristics of aeroneuroses occurring in a bomber-crew training unit are discussed. Stress is placed on the value of observation during flight in diagnosis and prognosis. It is stated that successful prevention and treatment of these conditions demand a more understanding approach to the flier's problems with respect to living conditions, recreation, and leave. The importance of personal experience to the flight surgeon is emphasized. *The Journal of Aviation Medicine*, December, 1943, pages 373–377.

Medical Problems of the Civil Air Patrol, Office of Civilian Defense. Lt. John G. Stubenford, III. The principal duties of the flight surgeon are outlined in paragraphs covering the initial examination, periodic examination, preventive medicine, clinical medicine, and academic research medicine. Information is given about the Civil Air Patrol. In conclusion it is stated that an aviation medical officer of the Civil Air Patrol, in performing his duties, can unequivocally contribute much toward the success of organized civil air defense. *The Journal of Aviation Medicine*, December, 1943, pages 378–381.

Notes on Classification, Selection and Training. Second Lt. Ben Kaufman. It is stated that there are six or seven points or divisions in the career of a pilot where certain measuring rods are used to determine his probable success and, if the standards are met at these points, the pilot aspirant goes on to the next test of his flying sufficiency.

The writer discusses the intelligence test, and physical and psychologic tests for the purposes of selection and training. He considers reasons for the large percentage of elimination which occurs in the primary program of flying training. Solutions to the problem are suggested. *The Journal of Aviation Medicine*, December, 1943, pages 383–385.

Dashboards Don't Get Dizzy. Major Harry Mantz. This article deals with the limitations placed upon the pilot in the air by the construction of his sensory organs and demonstrates why instruments are more dependable than human senses in piloting a plane. Briefly explaining the physiology of the kinesthetic, vestibular ear-canal, and visual senses, it explains how the reactions of these three senses under certain conditions result in such phenomena as vertigo, the sense of turning in the opposite direction, flying upside down without being aware of it, the inability to determine how near to the ground one is flying, spiraling without knowing it, etc. Difficulties of the transition from contact flying to instrument flying and the dangers of combining the two are noted. *Western Flying*, January, 1944, pages 40, 41, 86, 2 illus.

Metallurgy

Anodic Films. A report by the staff of the Metallurgy Division of the Royal Aircraft Establishment regarding an examination of anodically treated aluminum-alloy parts taken from German aircraft. Information concerning the anodic films found on the samples is listed. The report describes how observations on film thickness were made. *Aircraft Production*, January, 1944, page 48.

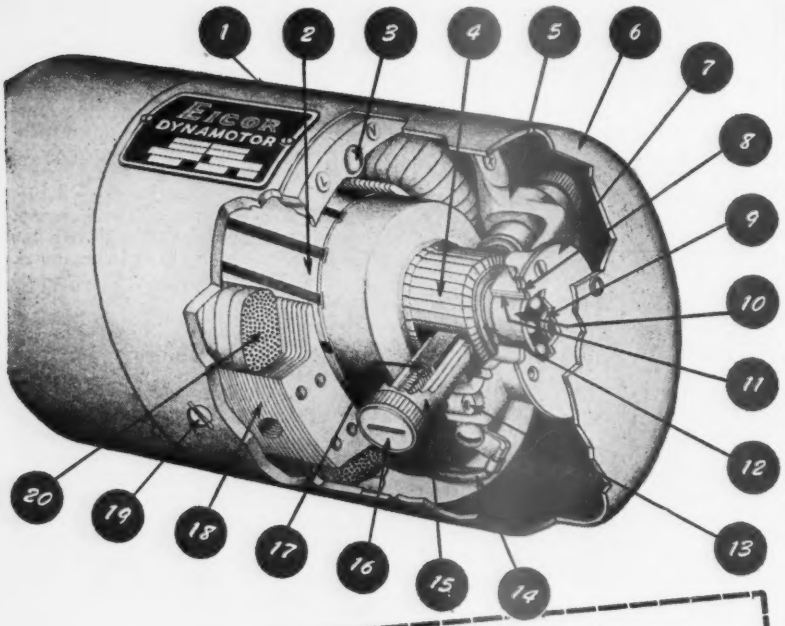
Superheating of Magnesium. A short commentary on what is called a well-known but little-understood phenomenon. The reaction of aluminum-base and magnesium-base alloys to superheating is compared. *Light Metals*, November, 1943, pages 528, 529.

The Metallurgy of Modern Alloys. R. H. Harrington. The tenth installment of this article on heat-treating definitions for modern alloys deals with the role of strain in precipitation reactions in alloys. Sections cover the classification of the role of strain in precipitation hardening, precipitation hardening with thermal elastic and plastic strain from the solution quench preceding the precipitation reheat, and precipitation hardening with mechanical plastic strain (cold-work) intermediate to the solution quench and the precipitation reheat. *Steel Processing*, January, 1944, pages 41–43.

Meteorology

Weather. This article covers the importance of weather forecasting in war, the meteorologic services in the U.S. Army, and the improvement of equipment and techniques. It contains data on the U.S. Army's present organizational setup for obtaining weather information, as well as data on some of the devices and methods used. As described, the meteorologic branches of the Army are the Air Forces and the Signal Corps. The Air Forces makes the actual observations and forecasts, while the Signal Corps is charged with "the development, procurement, storage, issue, and major maintenance of meteorologic equipment used by the U.S. Army."

The article includes a description of a mobile meteorologic station, innovated by the Signal Corps. This truck moves with the advance observers wherever



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a half-track can go, contains all equipment essential to accurate forecasts, and is kept in operation by the Army Air Forces until a permanent airdrome is set up. Among the instruments mentioned as used extensively by meteorologists are the radiosonde, thermometer, psychrometer, thermograph, barograph, barometer, rain gauge, anemometer, and clinometer. *The American Pilot*, January, 1944, pages 16, 17, 1 illus.

Military Aviation

"Maintenance of Aim." By an R.A.F. Officer. An account of how Britain's Bomber Command formulated and followed its plan of air-combat tactics, together with specific explanations of how Bomber Command operates. It is stressed that Britain's decision to base her air power upon the employment of large numbers of four-engined bombers was made in 1936, three years before war started. In addition to showing how the British never faltered from this aim, the writer describes the flexibility that characterized the bomber force. He also indicates the superiority of the R.A.F.'s bombing principles as compared with Germany's concepts of air power.

Beginning with bombing policy and concluding with the bombing, stages in the operation of Bomber Command are outlined. The process is reviewed through the participation of the Air Council, Ministry of Economic Warfare, Chief of Air Staff, and Commander-in-Chief of Bomber Command; through the issuance of orders to the various group headquarters; down to station headquarters. Information is given about why certain targets are chosen for certain nights and the determination of such matters as which squadrons are to take part, bomb loads required, timing, and tactics. The procedure is then followed through the briefing period, the actual bombing raid, and the after period of interrogation. *Western Flying*, January, 1944, pages 46, 47, 94, 2 illus.; "Germany, Next Stop," Squadron Leader A. C. H. Purthrey, *Canadian Aviation*, January, 1944, pages 44-47, 68, 70, 12 illus.

A Numerical Theory of Air Tactics. By A. F. It is shown that an increase in the numerical strength of an air force will produce an increase in its fighting strength only when numerical considerations are given appropriate weight in the tactics employed. The writer proceeds to study and give the means of obtaining the greatest benefit from additions to the numbers of aircraft taking part in aerial battle. He refers to early theories of aerial warfare and their application to certain engagements in the present war. The importance of a large margin of technical superiority in overcoming an advantage in numbers is conceded, but it is held that superior performance is often a result of one or another of the phases of numerical superiority, such as more or larger guns or more engine power. The history of air combat in World War I is reviewed, and the progress made in the present con-

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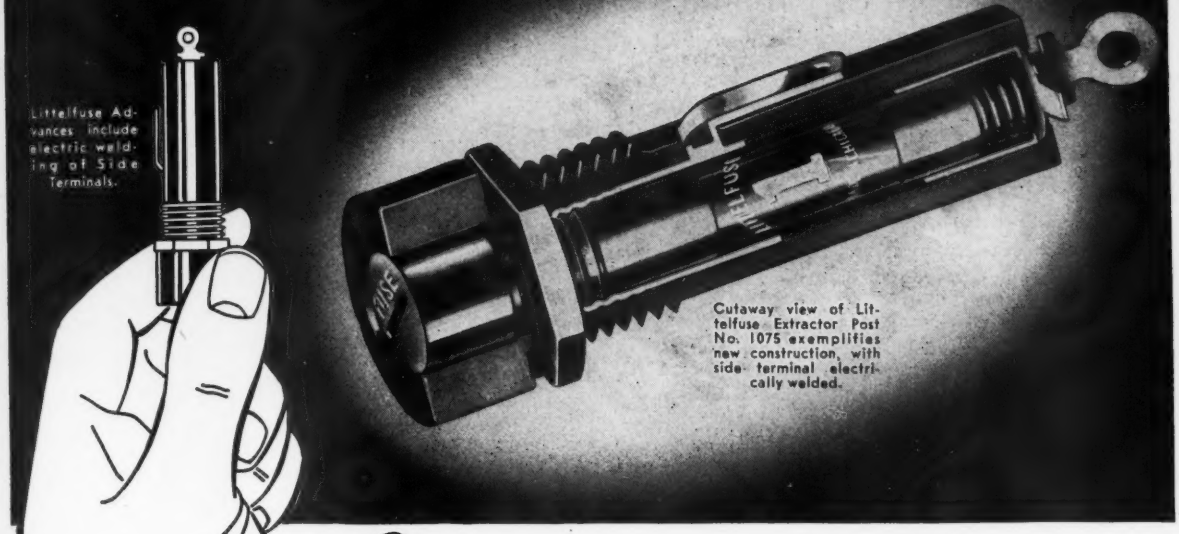
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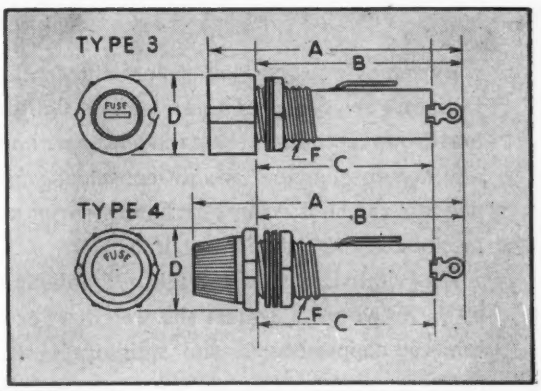

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...same size and shape

flict is noted. *Aeronautics*, January, 1944, pages 28–31, 1 illus.

Bombs Mean Variety. Willy Ley. Methods of dropping bombs on enemy targets are reviewed and the various types of bombs developed for the purpose are described. Information is given concerning the effect on target penetration of the weight of the bomb and the height from which it is dropped. Conditions for low-level and high-level bombing operations are outlined. Consideration is given to the way bombs bounce upon impact, and the use of skip bombing is described. Rocket bombs are discussed and sectional views of different types of bombs are shown. A chart gives bomb trajectories for different altitudes and speeds. *Air Trails*, February, 1944, pages 29–31, 89, 5 illus.

Model Airplanes

Miniature Air Force. Curtis Fuller. An account of how model aircraft of cellulose acetate plastic are fabricated by the Cruver Manufacturing Company. Manufacturing procedures are related, the advantages of cellulose acetate for this application are demonstrated, and variations in the methods of making different types of models are noted. The use of the model planes for training in aircraft recognition and range estimation is described. *Flying*, February, 1944, pages 50, 51, 136, 140, 3 illus.

Naval Aviation

Naval Aircraft in Combat. Lt. (j.g.) John B. Goodman. Stating that nearly 2 years of war have brought an almost entirely new lineup of combat planes in naval aviation, the writer proceeds to describe the performance of the various types of U.S. Navy planes in actions against the enemy. *U.S. Air Services*, January, 1944, pages 14, 15, 1 illus.

Personalities

Why Norseman Placed Among World's Finest Planes. Indicating the experiences which led up to the design of the Noorduyn Norseman, the history of Robert Noorduyn's affiliation with the aviation industry is recorded. In this article Noorduyn is credited not only with the development of the first cabin transport but also with having conceived the idea for the Fokker trimotor plane. *Canadian Aviation*, January, 1944, pages 51, 52, 2 illus.

Boss Bombardier. Mackinlay Kantor. A biographic sketch of Major General Frederick L. Anderson, Commanding Officer of the Eighth Air Force Heavy Bomber Command. The career of the 38-year-old General is traced through his early life, his years at West Point, his record in the Army until the war, his interest and specialization in aviation, and the successive jobs he has held since the war began. *Saturday Evening Post*, January 22, 1944, pages 16, 17, 77, 78, 3 illus.

One Name Stands Alone. Frank H. Ellis. A brief biography of Capt. F. J. Stevenson, stated to be the only Canadian ever awarded the Harmon International Trophy for outstanding flying. His career as a pilot is reviewed through his activities as a member of the Royal Flying Corps in World War I; ferrying World War peace conference officials between London and Paris; training Russian pilots; "barnstorming" for Canadian Aircraft Company; doing aerial forest patrol duty for the Ontario Provincial Air Service; and as a "bush" pilot for Western Canada Airways. *Canadian Aviation*, January, 1944, pages 59, 60, 62, 96, 4 illus.

Photography

The Strategic Eye—I. This installment of a two-part article on British aerial cameras is concerned with the Eagle series produced by the Williamson Manufacturing Company. It traces the historical development of the series and describes the design and construction of the cameras in detail. The latest models of Eagle aerial cameras are reported to be electrically operated automatic instruments with a self-contained motor and instrument records. Like their predecessors, they are built on a unit construction system that permits interchangeability of many parts between different numbers in the series.

A characteristic of the Eagle cameras, noted as one of the most important, is the provision of an optical unit in which the focal plane register glass is mounted in fixed relation to the lens. Conforming with the needs of military reconnaissance, the optical system is so arranged that the focal length can be quickly changed to suit varying requirements by interchangeable lens cones. On the other hand, accurate maintenance of the optical constant can be attained by the securing of the lens and focal plane in one inseparable unit. *The Aeroplane*, December 24, 1943, pages 728, 729, 5 illus.

Plastics and Plywood

Glider Control Tabs. The development of plastic plywood glider aileron flettners, aileron trim tabs, elevator tabs, and rudder tabs is described. Details of their construction are outlined. These plastic wood fiber trim tabs are being produced by a New England subcontractor on the basis of quantity-production assembly-line techniques, which are illustrated and discussed. *Modern Plastics*, January, 1944, pages 87–89, 9 illus.

Wood-Cloth and Wood-Paper Laminates. John Delmonte. The use of wood and resin-impregnated cloth or paper is discussed. It is stated that combinations of cloth and paper with wood, in addition to serving as vehicles for the bonding glue in the manufacture of the laminates, also help stabilize wood assemblies and provide structural advantages, as demonstrated by test data given in the paper. When a reasonably large number of paper laminates is used, there is an apparent increase in the tensile properties of wood, attributable to prestressing of the wood resulting from differences in coefficients of thermal contraction as parts are cooled upon removal from the press. Dimensional stability in plywood faced with phenolic-resin-treated cloth and paper has been found to be far superior to unprotected plywood, according to the writer. *Transactions of the A.S.M.E.*, January, 1944, pages 55–59, 4 illus.

The Future of Plastics in Aviation. W. Ward Jackson. The article discusses some of the steps that have led to the use of plastics in aircraft, their possibilities and limitations, and the part plastics should play in the future of the aircraft industry. Points that manufacturers were asked to consider when contemplating the use of plastics in place of metal are listed. It is stated that out of the wealth of data compiled during the last few years has come the realization that plastics have a definite place in the aircraft industry now and in the future. *Modern Plastics*, January, 1944, pages 100–103, 174, 176, 7 illus.

Characteristics of Plastics as Engineering Materials. W. F. Bartoe and D. S. Frederick. The characteristics of organic plastic materials which make them attractive to the designer and engineer are defined as low density, ease of fabrication, low thermal conductivity, available transparency, and low unit cost for mass-production items. It is stated that before full use of plastics can be made, however, it is necessary for both the designer and the engineer to have an extensive practical tabulation of their chemical and physical characteristics. Today's cut-and-try methods used with plastics must give way to theoretical design considerations.

The writers outline those things that should be considered in every application with plastics, illustrating their point with pertinent data on the thermoplastic resin known as Plexiglas. *S.A.E. Journal*, February, 1944, pages 54–61 (Transactions), 14 illus.

Molded-Laminated Phenolic Propeller Parts for Aircraft. This article describes the design and construction of laminated phenolic parts for controllable-pitch propellers. The production of the barrel support block, the spider phenolic ring, and the blade chafing ring for constant-speed and hydromatic propellers is discussed and illustrated. The blade butt spacer, used on certain four-bladed hydromatic models, and the laminated phenolic front mounting spacer, employed in the spinner of the P-51, are also described

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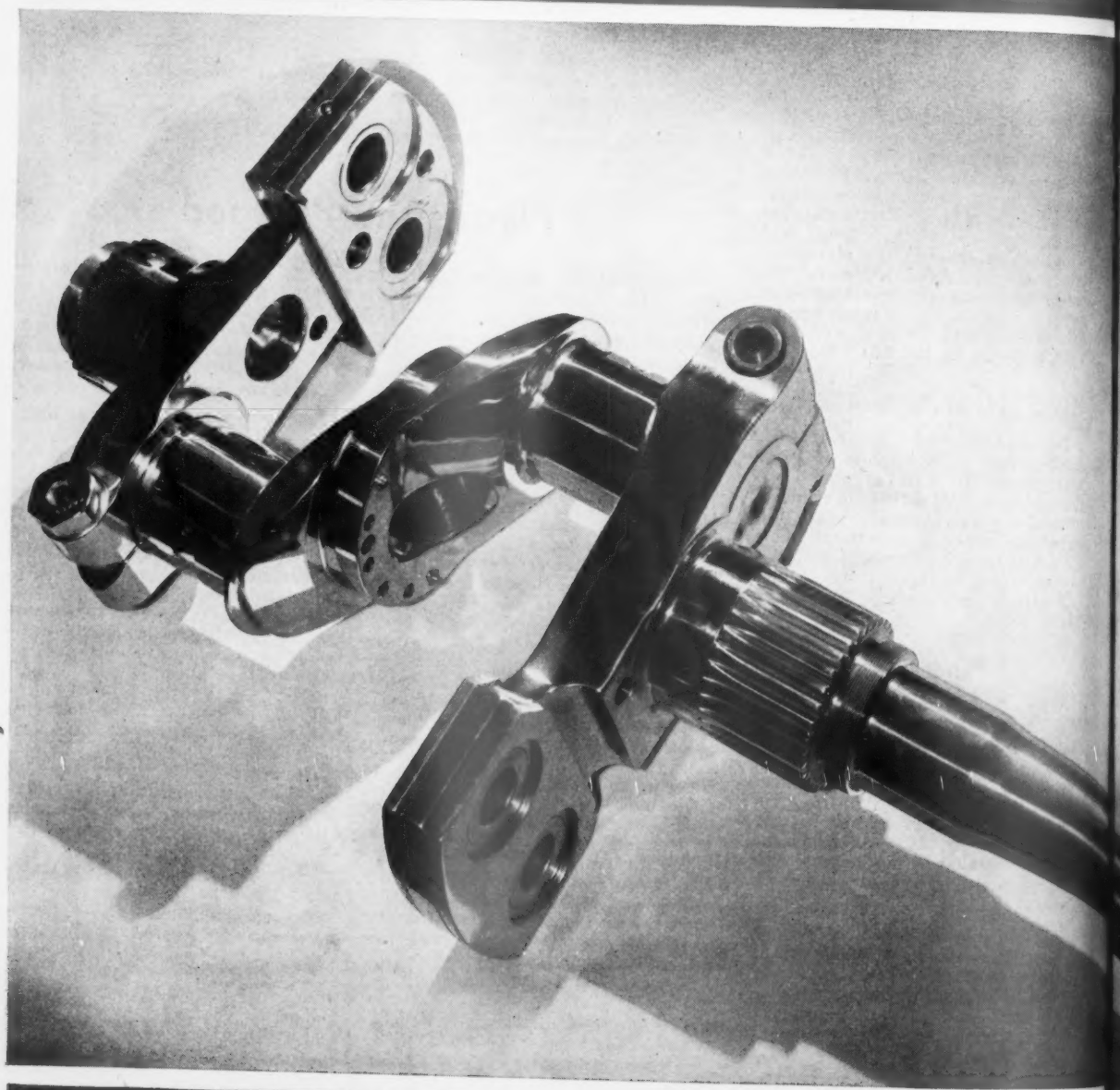

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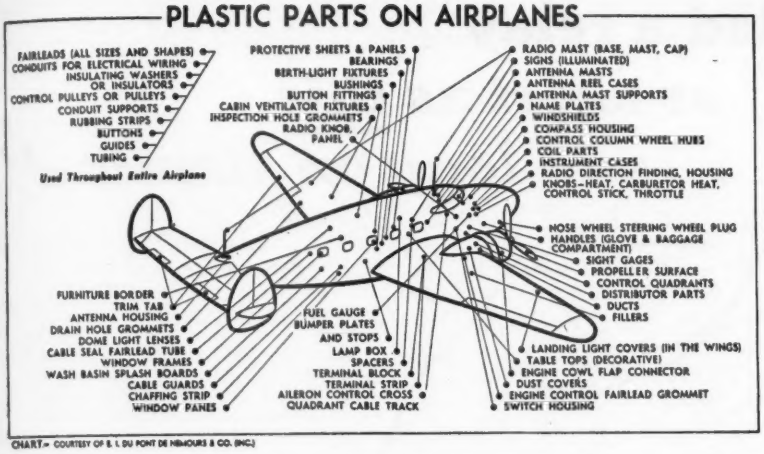

CHART.— COURTESY OF E. I. DU PONT DE NEMOURS & CO. (INC.)

All of these plastic parts and many others are being used today in passenger, freight, or fighting aircraft although no one plane may have all of them. For postwar planes additional equipment, such as seat covers, hand phone sets, cabin lighting fixtures, lavatory equipment, and various items of cabin trim and decoration is proposed.

in detail, covering the materials used and the machinery and methods employed. *Modern Plastics*, January, 1944, pages 109–113, 170, 16 illus.

High Frequency Heating in the Production of Plastic Bonded Wood Aircraft Components. C. B. F. Macauley. The development and use of electronic processing for improving the quality and speeding up the production of plastic-bonded wood aircraft components is described. As a prelude to the discussion, a brief introduction to electronics is given. It is stated that electronic processing—one development of the Duramold process—provides a satisfactory solution to the problem of getting a uniform degree of heat to all of the glue lines in a thick laminated section. To illustrate the importance of new bonding techniques, the writer outlines the classes of bonding materials or glues available. Methods of applying heat to the glue line are discussed, as well as the details of electronic processing. *Plastics and Resins Industry*, December, 1943, pages 3–8, 23, 24, 12 illus.

Use of Wood in Aircraft Design and Construction. Part II. J. J. Wallace. The second half of a two-part article on the application of wood to the design and construction of aircraft is concerned with the manufacturing problems involved. The two principal methods of wood aircraft manufacture—molding and flat plywood construction—are described. Factors influencing the choice of process, the choice of adhesive, and the selection of a finish are outlined, and problems of tooling are examined. Comparative manufacturing costs, including the cost of materials as well as the cost of production, are discussed, together with ways of reducing these costs. The article also covers methods of production breakdown.

In conclusion, it is suggested that the future development of wooden aircraft construction in the United States should be approached from the following aspects: (1) development of designs peculiarly suited to wood construction; (2) aggressive investigation of the reasons for the high cost of aircraft plywood and lumber and formulation of practical policies to cut these costs down; (3) emphasis in design on the special virtues of wood construction such as smooth skins, clean lines, easy repair, good soundproofing and heat-insulation characteristics; and (4) aggressive research to develop better ways of using wood, considering such possibilities as improved wood, composite plyboard, and low-density core plywood. *Aero Digest*, January 1, 1944, pages 79, 83, 139, 141, 142, 7 illus.

New Vinyl-Type Material. An account is given of the development of Marvinol, a vinyl-type plastic that in many cases may be used to replace rubber. It is stated that, while attention has been concentrated on inner tubes, gloves, and certain aircraft uses, many other products that are now made only from rubber have been duplicated.

It is noted that the extensive research necessary to develop the substance took place at the Plastic Research Laboratory of The Glenn L. Martin Company. *Pacific Plastics*, January, 1944, pages 10–12, 10 illus.

Plastics Aerial Masts. W. A. Cook. Molding and winding processes used in the manufacture of laminated-fabric and paper aerial masts for aircraft are described. The author states that masts made of laminated fabric plastics are light, strong, resilient, and do not require periodic painting. As an example of the work, the mast for the Wellington bomber is described, with details of its design and construction. *Aircraft Production*, January, 1944, pages 17–19, 9 illus.

Effects of Thermo-elastic Forming on Properties of Thermosetting Laminates. W. I. Beach. Following the development of the thermoelastic forming process, there was a need for factual data on the properties of formed laminates. Tests are described which provide data for present use and which give a basis for more substantial design criteria pertaining to the forming of thermosetting materials. It is stated that the information is sufficiently indicative to warrant a wider employment of formed laminates in many applications previously believed unsuited because of lack of data.

It is found that, contingent upon the magnitude and nature of the applied load, formed parts may be dealt with in such a manner that they ultimately possess better physical properties than were present in the flat, unformed sheet material. Judicious selection of thread direction is necessary whether the part has a simple right-angle bend or compound curvature. The author states that the data obtained from these tests are peculiar to one type of laminated product only. Others may produce better or inferior properties, depending upon the type of resin and fabric processed. *Modern Plastics*, January, 1944, pages 127–131, 186, 188, 17 illus.

Current Applications and Future Possibilities of Paper Base Laminates in Aircraft. Charles F. Marschner. This paper deals with the plastics development program of the McDonnell Aircraft Corporation, which had two main goals: first, the achievement of substantial increases in the mechanical properties of plastics; and, second, decreasing the molding pressures required in forming them. Important information first was obtained from mechanical tests of commercially available paper-base and fabric-base material in which the disadvantages of high molding pressures were momentarily disregarded.

Paralleling the mechanical tests, a series of low-pressure molding tests was conducted to determine uses and possibilities of various methods and types of dies. These tests included the use of rubber bags, rubber die punches, plastic die punches, sprayed metal dies, and plated metal dies, as well as cast and machined dies. Conclusions drawn from these molding tests are enumerated.

A table shows typical values for currently available high-strength paper-base plastics. These strength values are compared with those advertised for commercial paper-base plastics of 3 or 4 years ago, and the increase in the ultimate strength and elastic values is noted. The strength properties of parallel and cross-laminated paper-base materials at various angles to the grain are discussed. *Plastics and Resins Industry*, December, 1943, pages 9–14, 24, 8 illus.

High Duty Woods. John S. Trevor. An outline is given of the requirements of laminated and densified woods for aircraft propellers, structural components, production equipment, such as press tools and jigs, and electrical insulation. *Aeronautics*, January, 1944, page 32.

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Postwar Aviation

What I Would Do About Reconversion. Donald W. Douglas. The president of Douglas Aircraft offers a number of specific suggestions concerning the postwar reconversion of the aircraft industry from military to peacetime activity. His comments include the proposal that after the war the Government release to the air lines such C-47 transport planes as would not be required for policing and reconstruction, return C-54's to the Douglas company for conversion to passenger service, sell the reconverted C-54's to the air lines, and then take back the leased C-47's for disposal to some worthy ally such as China. With regard to Government-owned plants, he suggests that they be used for new community projects that will help take up the postwar slack in unemployment, for storage of war-plant machinery, and as Government supply depots. He also outlines the bonus plan he has asked the Government to consider for tiding aircraft workers over the period of readjustment. This bonus would take the form of an incentive-pay increase in wages, based on increased production and length of service. It would be cumulative and be payable only after the war or on final termination of employment. *Aviation*, January, 1944, pages 114, 115, 306, 309, 3 illus.

The Transportation Shortage is Our Opportunity. Don Valentine. A large potential market is indicated for personal airplanes after the war. The task of selling the idea of private flying has been eased by the creation of a deep-seated demand for personal travel through their experience with automobiles. An estimated pent-up demand for 12,000,000 automobiles is regarded as an outstanding opportunity for the aircraft industry to transform a part of that potential market into sales of personal airplanes. It is indicated that the automobile industry would require about 5 years to build the number of new automobiles for which a market exists now, and during that time many of those buyers could be converted into owners of aircraft.

It is shown that there should be adequate space for landing, such as landing strips in or close to every town, airfields for the larger communities, and suitable service facilities at a reasonable cost. Other needs indicated are plainly marked airways, simple weather reports, and easy methods of navigation. Suggestions are made for the establishment of what the writer terms air parks or landing strips with service facilities adequate for the traffic expected, advising against the tendency to overdo the matter of airports.

A twofold plan is suggested for the industry: first, to concentrate on building a good airplane that the average man can fly safely, at a price within his means; and, second, to do everything possible to promote the provision of suitable landing facilities. The writer favors the improvement of present designs of small personal plane, rather than to strive to develop with undue haste the ideal aircraft of the future. He emphasizes the responsibility of the industry to guide its potential customers wisely into the field of private flying, in return for which a large and profitable market is visualized. *Air Facts*, February, 1944, pages 34–40.

The Cab Grab-Bag. Jo Ellen Adams. An indication of the many types of applications for postwar air routes that are being handled by the Civil Aeronautics Board. Among the phases of air transportation noted as attracting many aspirants are feeder lines, pickup services and international air routes. It is stated that the C.A.B. is governed by the following policies in their consideration of the applications: (1) Amateurs in aviation need not apply; (2) railroads, steamship lines, and other modes of transportation will not be permitted to "muscle in" on the control of air carriers. (3) There will be no monopoly of United States foreign air transport by one United States line; (4) local air lines—pickup services in limited areas, helicopter bus services, and feeder services—will be encouraged in postwar activities to team up with long-distance express air lines rather than bus or railroad lines. *Flying*, February, 1944, pages 47, 114, 120, 1 illus.

Post-War Air Transport, Perhaps. C. G. Grey. The writer advocates the postponement of postwar aviation planning until after the war and discusses some of the problems that he claims will have to be solved before any concrete plans can be made. His thesis includes the points that as yet no "safe" aircraft has been developed for passenger service, that the gasoline engines of today will probably be replaced by reaction propulsion units, and that nobody knows the social or political conditions under which air transport will run after the war. In addition to that of Government control, he brings up the question of competition between shipping interests, railroad interests, etc., and notes the unknown quantity represented by the postwar aviation policies of other nations and the British Dominions. *The Aeroplane*, December 10, 1943, pages 668, 669.

When the Farmer Flies. W. H. Allen. The future of aviation in the field of agriculture is discussed by New Jersey's Secretary of Agriculture. He states that there will be opened a new and wide field of aerial services for agriculture which will make jobs for those who build and fly planes. Enterprising men and women will work out interesting and profitable careers and develop a business that will succeed because their services will be built around an essential industry—the production and distribution of food. Consideration is given to the possibilities of harnessing sub-zero stratosphere cold for food preservation. Other subjects discussed are aerial pest-control and the use of airplanes for fire fighting and as a sales help. *National Aeronautics*, January, 1944, pages 14, 56, 2 illus.

Canada—Heir to the Air? Grattan O'Leary. A statement of Canada's stand with regard to postwar international aviation agreements. Analyzing her strength as based on such air assets as geographical position, routes, bases, raw materials, and ownership of one-quarter of the polar islands, the writer reports that Canada is ready to cooperate with her Allies but that she is also determined not to take a back seat in peace-conference decisions or to be dominated either by Great Britain or the United States. *Collier's*, January 5, 1944, pages 54, 65, 1 illus.

Aircraft Industry—Unpredictable but with Unlimited Possibilities. E. E. Wilson. Figures are presented by the Vice-Chairman of United Aircraft Corporation on the expansion of the aircraft industry over the last 4 years. It is stated that the industry's problems are in proportion to the magnitude of its expansion. Three major factors of predominant postwar interest are listed as: first, termination of war contracts; second, disposition of surplus stocks; and third, disposition of surplus plants. The solution of these problems requires statesmanship and leadership of a high order.

It is stated that the action of Congress on these matters may promote or jeopardize the welfare of the aircraft industry and other industries. In closing, the writer emphasizes that, fundamentally, the future of aviation depends on how well the principles of individual initiative and enterprise are rediscovered and how well the efforts of the Government are directed toward utilizing them in promoting public welfare. *Machinery*, January, 1944, pages 150, 151, 2 illus.

Britain Ponders Future of Air Transportation as No. 1 Postwar Problem. Comdr. Stephen King-Hall. In this article the writer discusses postwar aircraft uses, the civil aircraft outlook, and problems of aircraft production and consumption. The importance of international cooperation in postwar aviation is stressed. Statistical comparisons are made to show the growth of air transport. Figures are tabulated covering the route mileage, passenger mileage, and traffic density of the air transport operations of Great Britain, United States, Russia, France, Germany, Italy, and the Netherlands in 1938. *Air Transportation*, January, 1944, pages 13–16, 1 illus.

Post-War Air Racing. "Pylon." Preceded by some notes on the prewar airplane races held in various countries, a suggestion for postwar airplane sporting contests is offered to the Royal Aero Club. They are advised to investigate again the possibilities of pylon racing as a basis for the events. It is stated that there should be different classes of race dependent on motor size—either swept volume or horsepower—and that handicapping should be eliminated. The possibility of hold-

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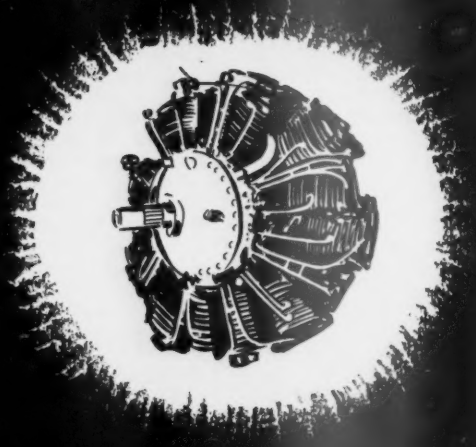

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ing a race week with a series of events each day, and perhaps a Royal Air Force display at the same period, is also offered for consideration. *The Aeroplane*, December 10, 1943, pages 672, 673, 6 illus.

Aviation Industry's Peacetime Potentials. Parts I and II. John H. Frederick. In a two-part survey, an overall picture of the aviation industry is presented, particular attention being given to merchandising aspects of the business. The postwar problem of how to keep as much as possible of the industry's war-born plant capacity going in peacetime is studied. The writer discusses airplane production, aviation markets, domestic air transportation, and the future expansion of air transport. It is stated that at the end of the war, from the standpoint of equipment and new engineering experience, the air lines will still be ahead of public acceptance both for travel and shipping and that there will be a big selling job to be done so that the demand for their rapidly developing facilities will rise promptly enough to justify expanding operations.

The latter part of the survey touches on Government export trade, private flying, and commercial operations. It is concluded that, despite the possibilities for increased use of air transportation for commercial and private activities, after the war there will not be a market for all the productive capacity of the plane producers as they exist today. *Printers' Ink*, January 21, 1944, pages 17–20, 90, 4 illus; January 28, 1944, pages 25, 26, 29, 1 illus.

A Plan for Today's Aircraft Tomorrow. Al. Hansen. A plan is proposed for the postwar disposal of surplus airplanes and aviation equipment owned by the Government. It is suggested that for purposes of reducing the national debt this material should be made available to any one who wants to purchase it. To possible objections of aircraft manufacturers that this would stalemate their business, it is pointed out the equipment could only be used for certain commercial purposes, that at best it would only be used temporarily until more efficient and economical aircraft could be manufactured, and that—far from impeding future sales—it would help to stimulate a demand for airplanes during the period of reconversion. For the method of distributing the surplus aircraft, it is advocated that the sales problem be handled by some agency of the Government and not by middle men under control of private interests, in order to enable as much money as possible to revert to the U.S. Treasury. *Western Flying*, January, 1944, pages 48, 96, 120, 1 illus.

Private Flying

Do Our Weather Rules Make Sense? Wolfgang Langewiesche. The writer suggests the revision of some of the weather rules, taking the position that the owner-pilot of a small personal airplane can fly very well without elaborate instrument equipment

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Occupies less than half as much cross sectional area as solid bushing, permitting more latitude in design.

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Made from precision-shaped wire with no waste, requires about one-tenth as much metal as solid bushing made from bar stock.

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and that he can solve the weather problem by relearning the lessons of the past and flying *under* the weather. In this situation the private pilot's needs are opposite to those of the air-line pilot, who must have and use the best instrument equipment and take advantage of all the aids provided by modern science in the form of radio, direction-finders, deicers, and other mechanisms.

It is contended that private pilots can often fly with safety under weather conditions that prevent commercial flights, under the present regulations; that the rules should be amended; and that low-flying facilities should be provided. The ways in which present regulations discourage private flying are analyzed, and suggestions are made for changing them to conform with the capabilities of modern small private airplanes. After indicating what he calls inconsistencies in the current rules governing instrument and contact flight, the writer suggests four ways in which small-plane traffic could be kept going despite low ceilings, as follows: (1) lower clearance-above-terrain rules; (2) raise minimum instrument-flight altitudes; (3) reduce or abolish clearance-below-overcast; and (4) permit the contact pilot to file a plan in bad weather and proceed by contact flight just underneath the overcast—instrument pilots in the vicinity could avoid collision just as they avoid other instrument craft under present rules.

Suggestions are made for liberalizing the rules concerning visibility, also a factor held to be unfavorable for the progress of private flying. One is to provide low-approach lanes for private craft and another calls for special landing strips. Other ideas include the waiving of some of the present weather rules in the case of an experienced private pilot, and the provision of different weather minimums for different sections of the country. *Air Facts*, February, 1944, pages 9–22.

Production

Assembly Methods at Goodyear. Three examples illustrate the improvement of manufacturing techniques effected by the Goodyear Aircraft Corporation through the incorporation of automatic equipment for various assembly operations. Details are given about the construction, operation, and advantages of the automatic flush riveter, the "Akromatic" screw driver, and the motor-driven tape-wrapping machine. *Aero Digest*, January 1, 1944, pages 116–118, 8 illus.

T. P. Wright Traces Plane Program; Forecasts 110,000 Aircraft in 1944. T. P. Wright. The Director of the Aircraft Resources Control Office gives his own account of the aircraft production story and warns the aviation industry that it must meet an accelerated program for 1944. Figures are listed on the output of warplanes during the period covered, the percentage of increase in weight, the increase in the average weight of air frames, the rise in horsepower output, and the output of heavy bombers per month. Predictions are made regarding the aircraft industry's output for 1944. *Aviation News*, January 10, 1944, pages 7–11, 2 illus.

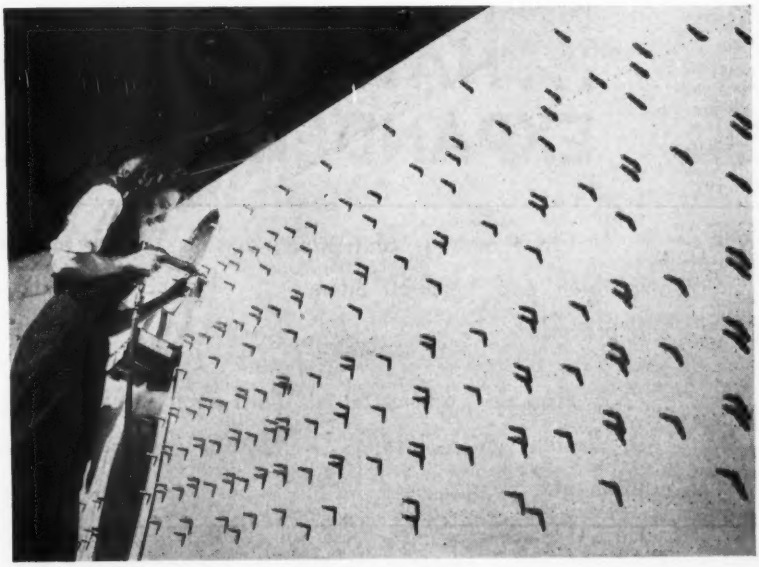
Laboratory and Production. W. A. Sparks. The writer discusses the enlisting of the scientific worker's knowledge to improve manufacturing technique. The discussion is based on the value of the laboratory, the development of processes, and technical control. *Aircraft Production*, January, 1944, pages 49, 50.

Refrigeration Speeds Shrink Fit Assembly. Fred W. Whitcomb, with Alfred C. Houser. The use of extreme low-temperature refrigeration for shrink-fit assemblies is discussed. It is shown that although this method is of relatively recent origin it has found widespread acceptance in industry. The advantages of shrink fitting over drive fitting and press fitting are listed. Three basic rules that should be remembered when shrinking two parts together are included. Information concerning the length of time a part must remain in the cold chamber to obtain its greatest shrinkage is given, and several applications of shrink fitting are listed. The postwar future of mechanical refrigeration for shrink-fit chilling is discussed. *Heating and Ventilating*, January, 1944, pages 45–48, 5 illus.

Aircraft Production Analysis Key to Assembly Line Efficiency. Part II. Loren F. Dorman. The second half of a study dealing with the analytical techniques by which the production of an aircraft is reduced to simple planning operations. Following a consideration of production breakdown, production and line assembly, and production control, this concluding installment is concerned with the precise allocation of working time to each operation. It also covers the use of production illustrations for the conveyance of detailed manufacturing information. *Aviation*, January, 1944, pages 179, 181, 183, 360, 363, 4 illus.

Quality Control through Shop Teamwork. Bert Holland. A description is given of the quality control system used by the Ryan Aeronautical Company. This system is designed to prevent factory errors from being repeated after they are first caught by inspectors. It is explained that the inspection department's responsibility ends when it finds an error and at that point the quality control department takes over. The duties of the quality control department are listed and discussed. Inspection-discrepancy report forms used by the department are illustrated. A chart shows the organization of the department. *Automotive and Aviation Industries*, January 1, 1944, pages 38–40, 64, 67, 68, 4 illus.

Future of Magnesium Castings. D. Basch. A paper, presented before the Philadelphia chapter of the American Foundrymen's Association, in which the properties of magnesium for sand, die, and centrifugal casting are evaluated. Suggestions are made regarding possible future improvements in magnesium alloys and casting methods.



Approximately 23,000 rivets are driven into every 28-ft. long horizontal stabilizer that Westinghouse builds for Glenn L. Martin Navy Mariner patrol bombers. To prevent the aluminum "skin" from being drawn out of place by riveting guns, sheet-metal clamps hold the covering tight to the framework until the riveters work up to the clamps.

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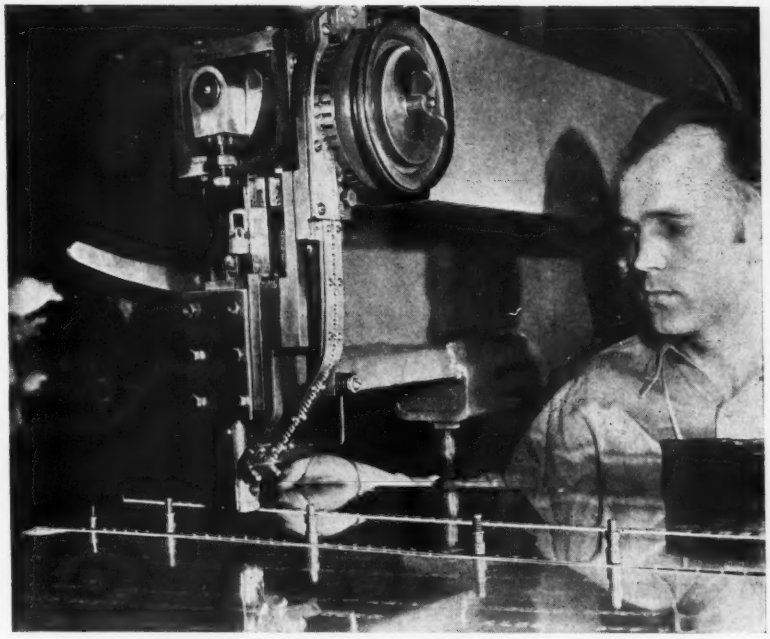
The writer discusses casting characteristics, the increased use of die casting, and centrifugal casting. *The Iron Age*, January 13, 1944, pages 54–57, 1 illus.

The Principles of Lubrication in Modern Deep Drawing Practice. H. A. H. Crowther, P. D. Liddiard, and K. I. Marwood. In the second and third installments of this article on lubrication as applied to deep drawing, the writers briefly discuss the properties of tools and then consider the classes of material that are available for lubrication purposes. The relative merits of these materials are reviewed in the light of the theoretical considerations that were set forth in the first installment of the article. Specific factors are given which must be recognized as conditioning the choice of raw materials to be employed in the formulation of deep-drawing lubricants. These include chemical and mechanical factors and the psychologic and physiologic aspects with reference to the effects on the workmen. Defects due to poor drawing and the application of lubricant are discussed in other sections. *Sheet Metal Industries*, November, 1943, pages 1915–1920; December, 1943, pages 2099–2105, 2 illus.

Dehumidifying the Core Storage Room of Big Magnesium Foundry. Realto E. Cherne and Charles G. Murphy. Reference is made to the unique problems that must be solved in the magnesium foundry. One of these is the need for the special handling of cores to prevent moisture pickup. The dehumidification system installed in the core storage room of the Wright Aeronautical Corporation's Lockland magnesium foundry is described. A combination of well-water precooling, direct expansion refrigeration, and silica gel dehydration is used to maintain the necessary low relative humidity and proper temperature conditions for core making and storage.

The writers explain how the system was designed, its operating cycle, and its control. *Heating Piping & Air Conditioning*, January, 1944, pages 1–6, 6 illus.

These Horizontal Jigs Boost Aircraft Panel Fabrication. Ralph H. Ruud. This article covers North American Aviation's method of employing horizontal Masonite jigs instead of vertical steel units for the production of aircraft panels that are too heavy to punch or rivet. In giving the new panel-fabricating procedures, the use of traveling jacknife drills and combination drill-countersinking tools are described as features of the system. The economy effected through the substitution of the horizontal patterns is reported to be a reduction in man-hours from 300 to 77.5 per jig. Other advantages claimed for the new method of fabrication are: better quality, less operator fatigue, release of hand drills for other work, reduction of drill breakage, elimination of stringer clamps, fewer mistakes, and simplification of new-employee training. *Aviation*, January, 1944, pages 176, 177, 5 illus.



Goodyear Aircraft Corporation's automatic flush-riveting machine.

Heat Treatment and Aging of 24S Aluminum Alloys. Max E. Tatman and Ray A. Miller. A summary of tests on 24S clad aluminum-alloy sheets and 24S extrusions, undertaken by Consolidated Vultee. These reports embrace investigations on aging at temperatures from 325° to 400°F.; the effect of plastic deformation on aging characteristics and the degree to which variations in deformation effect aging results; corrosion tests on aged alloys; and the effect of heat on mechanical properties and on color of protective coatings and camouflage finishes.

All mechanical properties noted were taken with the grain of the sheet. *The Iron Age*, January 27, 1944, pages 50–55, 3 illus.

Weber Glider Wing Production. Arnold Johnson. An account is given of the production techniques employed by a subcontracting firm for the manufacture of CG-4A plywood glider wings. Special procedures and machines devised by the company are noted, while methods, controls, and tooling are discussed under two categories: overall and individual.

In examining the individual applications, the glider wing is followed through ten major steps of fabrication. These include: (1) fabrication of the spar caps; (2) assembly of the spar; (3) spar drilling; (4) application of spar fittings; (5) leading- and trailing-edge assemblies; (6) skin fabrication; (7) final assembly of wings; (8) cleanup before transfer to dope room; (9) doping; (10) application of insignia and decals, and shipping. *Aero Digest*, January 1, 1944, pages 122–124, 136, 139, 8 illus.

The Development of Aircraft Detail Fittings. Part IV. W. Cookson. In this continuation of an article about the production of detail fittings for aircraft, the writer describes how to calculate the position of 90° bend lines and explains the development of a stiffener plate template and a tube bracket. *Sheet Metal Industries*, December, 1943, pages 2126–2128, 3 illus.

Methods of Forming Aluminum Alloy Extrusions, and Preformed Sheet Metal Sections. William Schroeder. New methods and techniques for the forming of smoothly curved or contoured parts from extrusions and preformed sheet-metal sections are discussed. Manual and semimanual forming methods are described in sections dealing with hand forming, bending with the arbor press, and rolling. Most of the article is devoted to machine forming methods.

The writer discusses the use of the Yodercam bender, the mechanical-press method of bending with dies, the wiping shoe method, extrusion stretch forming machines, and the contoured bar rolling method. *Automotive and Aviation Industries*, January 15, 1944, pages 28–31, 100, 9 illus.

Centrifugal Casting of Aero Cylinder Barrels. Harold L. Flynn. An account of the centrifugal casting methods by which the Ford Motor Company of Canada produces cylinder barrels for the Armstrong-Siddeley "Cheetah" engine. In addition to detailing the techniques employed, the article indicates the efficiency and economy that were attained by replacing the former system of manufacturing these aircraft cylinder barrels from forgings.

Information is also given about the company's method of making exhaust ejectors for the Avro Lancaster by

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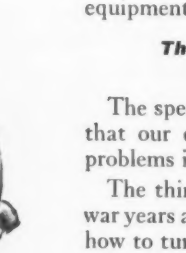

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means of special "two-piece" die designs. *Commercial Aviation*, December, 1943, pages 102, 104, 3 illus.

Manipulation of Light Alloy Sections. J. Aherne Heron and L. N. Hocking. The results of an investigation into the factors concerned in the use of direct electrical heating for bending light-alloy sections are described. It is noted that, as a process, direct electrical heating is not entirely new, since it has already been used successfully for heat-treatment and straightening of drawn steel sections for Armstrong Whitworth spars. In suggesting this method for production bending, the writers emphasize that a considerable amount of investigation is still required. The discussion covers electrical losses, power required, and control equipment. The advantages are summarized as follows: low capital cost; forms intricate shapes in one operation; possibility of low-cost forming jigs; great efficiency and economy over a wide range of sections; offers possibility, with development, of heat-treatment after forming and while still in the jig to eliminate distortion and lessen number of operations. *Aircraft Production*, January, 1944, pages 3, 4, 6 illus.

Plastic Solves Hot-Doping Problems. R. H. Natwick. A description of how the use of a synthetic plastic solved the problem of finding a wear-resistant flexible conduit for use in the hot-doping process adopted by the Pan American World Airways System for finishing the fabric-covered surfaces of its B314-type clippers. It is stated that the hose adopted after many tests has a core of solvent-proof, rubber-like tubing made of Compar, a special type of vinyl resin developed by the Resistoflex Corporation. *Plastics and Resins Industry*, January, 1944, pages 9, 10, 2 illus.

The Percival Proctor. Wilfred E. Goff. A description is given of the manufacture of one of the smaller types of British trainers which has possibilities for postwar private use. The Percival Proctor is a folding-wing monoplane of all-wood construction and is used for radio training and night flying. It is powered by a de Havilland Gipsyqueen six-cylinder, in-line, air-cooled engine. Sections of the article cover the construction and manufacture of the fuselage, the design of the folding wings, wing manufacture and assembly, undercarriage design, and the final assembly of the trainer. *Aircraft Production*, January, 1944, pages 5–12, 23 illus.

New Assembly System at the Douglas Plant. The illustrations and text of this article portray the production-line technique that has greatly increased the output of A-20 Havoc bombers at the Douglas Santa Monica plant. The result was attained by the installation of a complete "flow-line" motor-powered assembly system, consisting of final assembly line and subassembly lines of tubular jigs that are synchronized for production operations and coordinated through a central control panel in the plant manager's office. Installed in a building 700 ft. long, the lines of moving jigs total 6,100 ft. in length. *Automotive and Aviation Industries*, January 15, 1944, pages 20, 21, 98, 100, 5 illus.

Flying Jeeps on the Production Line. Joseph Geschelin. Production of the Stinson Sentinel or "Flying Jeep" by the Stinson Division of Consolidated Vultee is described. It is noted that these aircraft are built in a compact and modern plant, which employs on a small scale the same advanced production methods found in the largest air-frame plants. However, because of relatively limited facilities, many of the components such as wings and flaps are made by subcontractors. An account is given of how the fuselage, wing assemblies, and final assembly are handled at the plant. *Automotive and Aviation Industries*, January 1, 1944, pages 34, 35, 5 illus.

The Formation of Sheet Metal Components by Means of the Air-Operated Drop Stamp. A. T. Pierce. The economical production of sheet-metal aircraft parts of complicated form is discussed in this first of a series of articles. The use of the rope-lift gravity drop hammer is described. Advantages of the air-controlled drop-stamp for the gravity production of these parts are given. It is explained that two main advantages of air-controlled machines as compared with ordinary rope-drop hammers are that all operations can be easily controlled and the sensitivity of the machine enables the operator, without fatigue, to move the ram rapidly and with as much pressure as the work requires, at the same time keeping the work under visual supervision. Sections of the article cover soft-metal tool performance, tool design, and casting and mounting. *Sheet Metal Industries*, December, 1943, pages 2145–2148, 9 illus.

Avion Conveyor Lines. A series of notes on the conveyerized assembly lines installed by Avion, Inc., for the production of tail stubs and nacelle assemblies for attack bombers. Contrary to the usual practice of developing conveyerized lines after production is under way, this system was initially planned along with the original layout of production operations. It consists of five separate overhead conveyer units carrying all major assemblies and subassemblies through various production stages and reducing manual labor to a minimum. Features of the jig line monorail, the vertical stub line, the horizontal stub line, the nacelle subassembly line, and the nacelle final assembly line are outlined. *Western Flying*, January, 1944, pages 74, 75, 4 illus.

Auxiliary Plate Set System Accelerates Multiple Punching. Frank H. Limburg. Details are given on the construction and operation of a multiple-punching device credited with increasing the production perforation of aircraft sheet-metal parts by 25 per cent. Two plates, separated by spacer bars, form the basic units of the assembly. With the upper plate containing the punches and the lower plate the corresponding dies, the entire fixture is located on the platen of a press. The work is placed between the plates and the head of the press is dropped to push all the punches through simultaneously. Since all the punches are standard parts easily slipped into or removed from the plate set, a feature of this perforating method is that punches may be easily removed from the plate assembly on completion of the run and placed in immediate service again in another plate set. *Aero Digest*, January 15, 1944, pages 130, 132, 5 illus.

International Co-operation Builds Canada's New Avro-Ansons. This article relates how Canadian production of the Anson V is augmented by subcontracting work done in the United States. It contains general details of the manufacture of Anson components by the Universal Moulded Products Corporation and tells how the facilities and woodworking experience of the Aeolian American Corporation were acquired for the accomplishment of the work. Conducted under the patented Vidal process, manufacturing activities cover the production of the Anson fuselage, nose, nacelle, and wing-root fairings. Fuselages are also assembled and finished at the Universal Moulded Products plant. *Commercial Aviation*, December, 1943, pages 122, 124, 5 illus.

The Halifax Undercarriage Bridge Casting. J. A. Oates. The foundry methods employed by a firm engaged in the production of the magnesium-alloy bridge casting fitted to the Halifax bomber are described. It is stated that this is probably the largest casting yet made in this material. The writer tells how foundry technique was completely revised in order to insure the regular quantity production of these castings. Each casting is subjected to radiographic inspection comprising either 16 or 29 exposures.

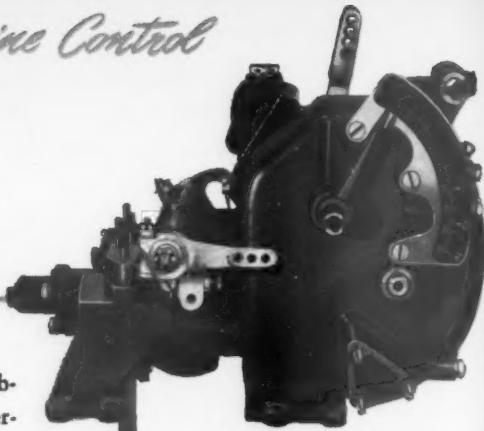
The latter portion of the article covers the machining operations performed at another factory, where horizontal boring machines, tooled for quantity production, are extensively employed. *Aircraft Production*, January, 1944, pages 21–31, 36 illus.

A Casting from Milwaukee. Andrew R. Boone. A description of how Boeing, with the help of more than 1,100 outside venders, is carrying out the quantity production of Flying Fortresses. Details of the Boeing system of manufacture are outlined. *Air Trails*, February, 1944, pages 16–18, 84–86, 6 illus.

Production Analysis and Control Smooth Assembly Operations. Lt. (j.g.) Harry S. Wharen. This article tells about the careful planning and control necessary in order to assure mass production of a new design. How the McDonnell Aircraft Corporation, with a contract for a new trainer, a new plant, and a limited labor supply, solved the problem, is described. Intensive use was made of production illustrations with work-by-position and inspection

Simmonds-Hobson Automatic Engine Control

A STEADY HAND AT EVERY THROTTLE



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Simmonds-Hobson Automatic Engine Controls have been specified for the most advanced types of fighter planes, where they are performing an outstanding job under exacting military requirements. Through continued research and refinement, new and more advanced designs, extending to the propeller governor, spark, and other engine functions, will be available to render increased service for peacetime assignments.

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sheets. The production control system is described in detail. *Wings*, January, 1944, pages 833–837, 8 illus.

Mass Production of Kirksite Blanking Dies. W. W. Broughton. The practice in making Kirksite blanking dies for aluminum-alloy sheet-metal parts as carried out in a number of aircraft plants is reviewed. How the Consolidated Vultee Aircraft Corporation solved the problem of obtaining blanking dies quickly and cheaply through the use of Kirksite die material is described. The Douglas Aircraft Company, Inc., modified the procedure developed by Consolidated. A complete description is given of the various steps in the sequences developed by Douglas. Variations of this procedure used by other aircraft manufacturers, including Northrop, Boeing, and Ford, are outlined. *The Iron Age*, January 20, 1944, pages 70–74, 8 illus.

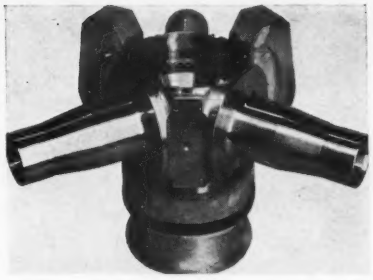
"Straight-edge of Light" Checks Big Assembly Jigs. E. J. Tangerman. An optical-mechanical method for checking aircraft fixtures which is used at plants assembling Lancaster bombers is described. It is noted that this is one of the principal developments that have made possible the complete interchangeability of fuselage components. The writer states that errors of alignment of 0.01 in. at 50 ft. and of parallelism of 6 sec. of arc (1 part in 30,000) can be detected by this optical-mechanical system, which assures complete interchangeability without fitting and assembly reaming. *Wings*, January, 1944, pages 829–832, 10 illus.

Propellers

One-Man Dolly Slashes Propeller-Mounting Time. Details are given on a lifting device that facilitates propeller mounting on the C-87 Liberator Express. This dolly is credited with saving 3 hours of propeller-installation time for each C-87. It also replaces the work of four men with that of one and eliminates the necessity for using a monorail crane.

The new mounting device is described as consisting of a mechanical ram to lift the blades to the proper level and a supplementary hand-operated hydraulic ram with a cantilever shaft attached to a rack and pinion gear, which moves the propeller forward, projecting it above the platform to the engine shaft. Fixed on a horizontal, Y-shaped dolly with three rubber-tired wheels, the mechanism can be wheeled along like a wagon. *Aviation*, January, 1944, pages 224, 325, 326, 329, 330, 333, 3 illus.

Pitch Panic. The story is related of how the propellers of the Spitfires, Hurricanes, and Defiants were hurriedly converted from two-pitch to constant-speed just prior to the Battle of Britain. The changes were effected in the field by the de Havilland company, and the job was marked by the urgent necessity for speed. In addition to describing the changes that had to be made for the conversion and the equipment required, the article indicates the advantages offered by replacing the two-pitch with the constant-speed propellers. *Flight*, December 9, 1943, pages 648, 649.

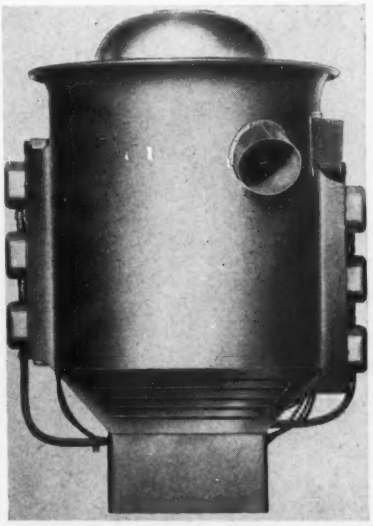


Courtesy of Hamilton Standard Propellers Division

A molded, laminated spider of a hydromatic propeller showing two of the barrel support blocks in their correct place.

Aircraft Propeller Blade. Elek E. Bendek. Part two of an article on the production of welded-steel aircraft propellers covers the design and construction methods of a simplified welded structure proposed by the writer. Explanations are given of the welding technique and fixtures used. A blade structure is suggested for an improved, streamlined, lightweight propeller for large airplanes. Savings in cost of material, jigs and fixtures, and labor which may be accomplished with the simplified structure are enumerated and discussed. *The Draftsman*, January, 1944, pages 22, 43, 1 illus.

Airscrew Blade Twist Effects. J. Lockwood Taylor. For the purpose of strength calculations, as well as the estimation of torsional rigidity, the propeller blade ordinarily is regarded as flat—that is, as if designed for zero pitch. (The effects of the twisted form of the blade in causing departures from the classical bending and torsion theories are regarded as secondary.) The writer points out that it has never been proved that these are actually negligible. An approximate analysis is presented which indicates that they may in some cases be appreciable. The investigation is given in sections covering torsional stresses induced by bending, modification in bending rigidity, longitudinal stresses induced by torsion, and increase in torsional rigidity. *Aircraft Engineering*, December, 1943, page 340.



Built by Aircooled Motors Corporation, this six-cylinder, opposed, air-cooled Franklin engine, designed to power postwar helicopters, is already in service in several experimental craft. The circular housing forces cooling air around the engine from the engine-driven fan at the top.

Research

NACA the Force Behind Our Air Supremacy. A brief outline of the history and functions of the National Advisory Committee for Aeronautics. To indicate the importance of the Committee's role in the present war, a general description is given of the research work that is being carried on at its several laboratories. The progressive increase in the scope of the N.A.C.A.'s activities, appropriations, personnel, and equipment, since its inception in 1915, is noted. *Aviation*, January, 1944, pages 175, 364, 1 illus.

Rotating Wing Aircraft

Helicopter. Col. H. F. Gregory. In this story of the helicopter, the history of rotating wing aircraft is traced and the technical development of vertical flight is outlined. The writer describes the present state of helicopter progress and discusses its future commercial possibilities. Early helicopter designs and tests are reviewed and reference is made to the German designs. It is noted that before the first successful helicopter was built, engineers turned to the gyroplane (proprietary name: "Autogiro") for their lessons. The difference between the helicopter and the two types of gyroplane is explained, and the development of Sikorsky's first successful helicopter is traced. The design and performances of the Army-Sikorsky helicopter are discussed at length.

It is stated that helicopters may be the answer to many postwar problems in transportation for industry, military service, scientific survey, agricultural control, exploration, and many other fields but that whatever happens is dependent on what is learned from the present helicopter and how well it is improved. *Air Trails*, February, 1944, pages 13–15, 72, 74, 7 illus.

Helicopter Design Trends. C. B. F. Macauley. A survey of the aerodynamic and mechanical principles that are being employed in the design of current helicopters, with descriptions of specific models. As representative of the single-rotor-type helicopter, the operating principles and features of the Sikorsky XR-4 are discussed. In addition to the twin-rotor helicopter with side-by-side arrangement, as exemplified by the Focke-Achgelis, information

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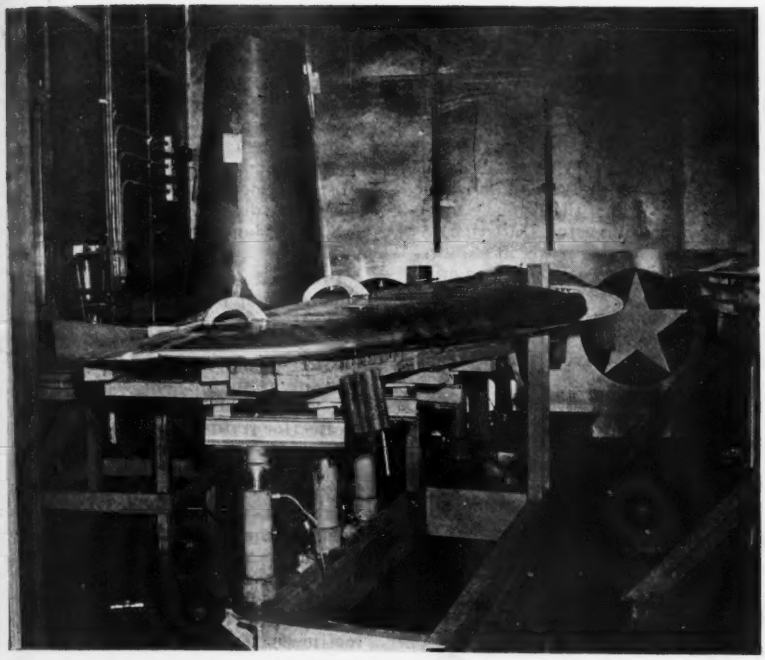

To test fatigue characteristics, this stabilizer was given 33,000 successive load applications at Consolidated Vultee. The stabilizer withstood the test without failure.

is given about the PV-2 and the helicopter to be manufactured by Higgins Industries, Inc.

Summarizing the general trends, it is concluded that the single-main-rotor design offers the greatest simplicity coupled with the advantage of less structural weight. The major disadvantage is that approximately 15 per cent of the craft's power, depending on the individual design, must be diverted to the work of counteracting torque. Many methods of decreasing this loss of power, ranging from utilization of exhaust or blower jets to employment of a gyroscopic transmission, are reported to be under study. It is further stated that twin-rotor designs, however, suffer the disadvantage of virtually doubling the statistical probability of mechanical failure of complex machinery. The additional structure required increases weight and drag, and coaxial rotors involve loss of efficiency of the bottom rotor because of interference from the slipstream of the top rotor. *Aero Digest*, January 15, 1944, pages 74, 75, 217, 219, 223, 5 illus.

Stress Analysis

Mechanics of Sheet-Metal Bending. William Schroeder. The basic mechanical phenomena occurring during the bending of sheet material are discussed. Analytic methods are given whereby all aspects of behavior during and after bending, such as forming pressure and spring back, can be accurately predicted on the basis of the stress-strain diagram of the material. An experimental and analytic study of the strain distribution in the bend is also included. *Transactions of the A.S.M.E.*, November, 1943, pages 817–827, 1 illus.

FATIGUE—the Forgotten Member of the DESIGN Family. H. O. Boyvey. Noting that useful information on the fatigue properties of aircraft constructional materials is meager, the writer offers suggestions for a practical method for predicting accurately the behavior of a material under repeated stress after it has been fabricated into a structural assembly. The purpose is to determine such weaknesses before large numbers of airplanes can be completed and delivered and to avoid the necessity of grounding all aircraft of a certain model, wherever they may be in service, for a period long enough to correct the faults. Credit is given for the efficiency of present design and static tests, but it is indicated that structures capable of carrying more than 150 per cent static design load will sometimes fail in service because of fatigue. Two variables that complicate the problem are indicated as (1) the magnitude of the stress and (2) the number of times during the life of the aircraft that the "above-endurance limit" stress will be applied. The term "fatigue limit" has been chosen to designate the value sought.

An explanation is given of the step-by-step process and the machines used in determining the fatigue limits of materials and of fabricated aircraft structures through establishing criteria or standards of comparison based on known service-life records. Examples are cited from the experience of Consolidated Vultee in testing an outer panel wing root fitting, a plywood stabilizer, and other parts. Details are given on the equipment employed in these tests. *Aero Digest*, January 1, 1944, pages 74–76, 126, 128, 133, 135, 136, 12 illus.

Comparing Structures in Metals and Plastics. Leslie P. Dudley. In this article a comparison is made between the structural properties of a plastic of the laminated veneer type and those of AZM magnesium alloy, Duralamin, and a typical grade of mild steel. *Light Metals*, October, 1943, pages 480–485.

Rectangular Tubes Under Torque. J. Ratzersdorfer. Information is given about the calculation of the bending moments and shear forces in the side, top, and bottom panels of a tube of given length and doubly symmetrical rectangular cross section, built in or simply supported at one end and free at the other. The tube is affected by uniformly distributed torques along the length and by a tip-applied torque and torques at intermediate points. The four sides of the tube are regarded as four separate beams that are joined together so that the box retains the original shape of the beams under load. The differential equation of the problem is developed and its solution is worked out with the aid of sketches and tabulated data. The case of two consecutive spans is considered by means of the three-moment equation. A tube of constant cross section is treated in a similar manner, as are other special cases, including a tube free at both ends and affected by concentrated torques at different points and a tube built in at one end and affected by various torques. Another problem is that of a tapered tube built in at one end with torque at the free end. *Aircraft Engineering*, December, 1943, pages 341–344, 11 illus.

Fabrication of Aircraft Parts. F. C. Hoffman. The use of the stress-strain theory in solving problems connected with the fabrication of sheet-metal parts for the aircraft fuselage is discussed. It is noted that the problem of spring back in formed parts, such as those with flanges, is related to basic stress-strain theory and the plastic behavior of metal. Tests indicate that percentage elongation values for a given material vary widely, depending on the distance between gauge points in the tensile specimen. The application of this basic theory to bar-forming of extrusions is given, and a problem in stretch-forming of a wing-cap channel is solved graphically. *The Iron Age*, January 20, 1944, pages 60–67, 17 illus.

Thermal Stresses in Structural Members. Leslie P. Dudley. A brief comparison is made among the stresses caused by temperature variation induced in structural members of Duralumin, AZM magnesium alloy, and mild steel. The writer discusses rigid members of homogeneous construction under axial loading, and the relative stresses attributed to bimetallic construction. *Light Metals*, December, 1943, pages 573–576.

Parts Straightening without Heat Treatment. J. A. Chamberlin. A procedure is outlined for evaluating the residual stresses produced by

cold-bending of aircraft parts or structures during the work of salvaging damaged aircraft. Cold bending is required in cases where the application of heat might damage the assembly and, accordingly, there is a need for defining the limits within which parts may be straightened without heat-treatment. Reference is made to established laws and theories concerning the stress limits of bars and tubes and their application to straightening operations. An example is worked out for straightening a bent tongue on the undercarriage lock fitting of an airplane. *Aero Digest*, January 1, 1944, pages 84, 88, 219, 5 illus.

Superchargers

Superchargers for Aircraft Engines. R. G. Standerwick and W. J. King. This is a comprehensive treatment of the development of turbosuperchargers. It is noted that the basic function of supercharging is to increase the intake-manifold air pressure in an engine, as a result of which the primary objectives of maintaining full (rated) power at altitude increasing power at sea level, and improving fuel ecomomy for cruising are attained. Fundamental design considerations covering the means for accomplishing these ends, with some indications of power requirements, temperature effects, and the like, are given. Types of superchargers and their systems of drives are discussed, and the General Electric turbosupercharger receives particular attention. Final sections of the paper are concerned with a comparison of various types of superchargers and the present and future prospects for this important aircraft-engine auxiliary. *Transactions of the A.S.M.E.*, January, 1944, pages 61–73, 14 illus.

Proposed Expressions for Roots' Supercharger Design and Efficiencies. F. A. Hiersch. This paper defines and gives equations for certain proposed positive-displacement-blower efficiencies in terms of slippage air, i.e. (1—vol.eff./100), which is taken as a means for rating the design of the blower. Another equation may be used to obtain what is defined as the "slip" polytropic-compression exponent. The first of two examples shows actual details of computation of optimum rotor-bore diameter and axial length for a given delivery volume, speed, impeller clearance, and head based on the methods given by K. Schopper. The volumetric efficiency for the given blower design is then compared with that of the optimum-design blower, and the results are applied to the appropriate equations. In the second example volumetric efficiency is plotted against the ratio of axial length to bore diameter with conditions fixed as in the first example. *Transactions of the A.S.M.E.*, November, 1943, pages 853–855, 1 illus.

Testing

Automatic Temperature-Recording Control System. M. E. Moore. This paper is devoted to a description of the automatic temperature-recording system developed by Douglas Aircraft Company, Inc. Designed primarily for use in flight-test work, the system may be readily adapted to test stands and the like. The system provides for the measurement of any number of points in groups of 24 each. The adaptation of this system to any automatic temperature-recording device is discussed and the requirements of such a device are stated. Design considerations are covered and the construction and operation of the system are described. *Transactions of the A.S.M.E.*, November, 1943, pages 809–815, 11 illus.

Radiation Pyrometry in Turbosupercharger Testing. Victor P. Head. Procedures are outlined for making measurements of the temperature of the wheel and buckets of turbines of the type used in turbosuperchargers. It is noted that such measurements are required under operating conditions with measurement tolerances varying from ±50°F. in flight tests to ±5°F. in certain ground tests, and this article covers the procedures used for measurements as low as 300°F. and upward. Four alternate procedures are defined under the headings of optical pyrometry, fusible alloys, fusible compounds, and contact thermo-

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couples. A brief outline is given of the general methods and applications of thermoelectric pyrometers and the arrangements of such instruments. Five tests are described, with comments on the results, and the conclusions are summarized under five requirements for basically sound thermoelectric pyrometry. The paper ends with a discussion of the capabilities and limitations of the instruments. *Instruments*, January, 1944, pages 36–40, 9 illus.

Best by Test. Sidney Swirsky. Interpreting the importance of experimental testing in the development of aeronautical design, this is a general survey of the testing methods and equipment employed in the experimental laboratories of several west coast airframe manufacturers. It also demonstrates how design criteria are modified as a result of test findings. Among the testing procedures noted are those relating to structural failure, winterization of aircraft, problems in fuel leakage, hydraulic apparatus, electrical installations, and special materials. Separate consideration is given to the tests conducted in the laboratory and those made while the plane is in actual flight. *Western Flying*, January, 1944, pages 60, 62, 98, 100, 1 illus.

Tools and Equipment

Scientific Marking of Aircraft Parts Aids Quality Control. C. A. Banze.

Detroit Stamping Company's self-adjusting toggle clamp adjusts itself to varying thicknesses of work. Its range is from 0 to $^3/_8$ in.

An outline of the various types, styles, sizes, and aircraft-production applications of equipment manufactured by the Jas. H. Matthews Company for inspection and identification marking. The devices described include: acid etching stamps for parts that would be spoiled by hammered impressions; steel stamps in letters, figures, and code symbol designs; stamps specifically designed for manufactured parts that are placed under torsion or tension or in which internal stresses of heat-treated steel are concentrated at the marking point; stamps made of a material called S-22 Synthetic, which are said to have from three to four times the lasting qualities of rubber stamps; pencil-top stamps; hammer-type stamps; and sand-blast stencils. The usefulness of this equipment for identifying the work of individual inspectors or revealing the source of manufacture is indicated. *Aero Digest*, January 15, 1944, pages 118, 120, 217, 7 illus.

Training

All-American Air Team. William Barry. An article on the Inter-American aviation training program. Conducted by the Civil Aeronautics Administration with funds from the Defense Supplies Corporation and the Department of State, this program provides for students from South and Central America to be trained in the United States as pilots, aviation mechanics, and aeronautical technicians. Its long-range goal is to enable other American republics to establish their own training facilities.

Courses are outlined and information is given regarding the qualifying of students for scholarships. *Flying*, February, 1944, pages 24, 25, 155, 156, 4 illus.

Giving Ground Officers Their Bearings. Part VI. Esther Forbes. Part VI in a series of articles on the training schools of the Army Air Forces deals with the preparation of ground crew officers at Yale University. The curricula for four different courses are outlined. These train officers for the maintenance engineering, armament, photographic, and communications divisions of the A.A.F. Entrance requirements for the courses and the basic training given to the students before they enter the Yale schools are noted. *Aviation*, January, 1944, pages 233, 235, 357–359, 4 illus.

Empire Central Flying School. A brief review of the history and present work of the Empire Central Flying School. Outlining some of the current problems on which the E.C.F.S. is engaged, the article interprets the school's function of coordinating and perfecting training techniques. Rather than concentrating on actual instruction, it is reported to be concerned with the development of uniform flight-training methods. The staff basis of the school and the functions of the Research, Handling, and Examining flights are related. Remarks are included on the men directing E.C.F.S. equipment, entrance requirements, examinations, and grading of students. *Flight*, December 9, 1943, pages 644, 645; "Empire Flying Training," *The Aeroplane*, December 17, 1943, pages 700, 701, 6 illus.

Speed-Up Solves Shortages for Contract Schools. Charles H. Williams. Based on talks given by three flight school operators at the Army Air Forces Contract Flying School Conference, this article surveys some of the timesaving procedures that were utilized by contract operators for the cadet training program. The most important "short-cuts" are summarized under twelve headings: improved gas trucks; public address system; binoculars; tug cars; floodlights; production-line maintenance; improved windtee; safety awards; protecting planes; two-way traffic; no reservations of planes by favored officers; and miscellaneous improvements. *Southern Flight*, January, 1944, pages 30, 31, 2 illus.

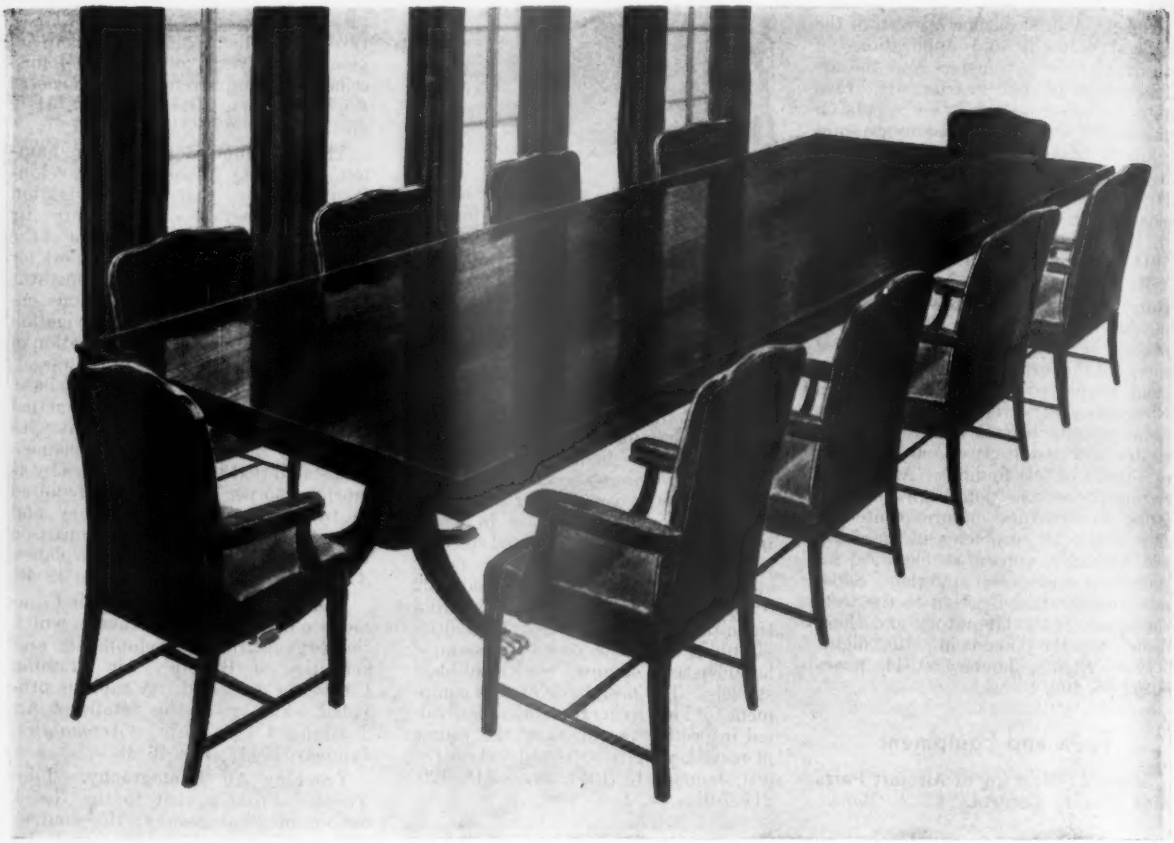
They Bombed Berlin in Binghamton. Albert Q. Maisel. The development of the Celestial Navigation Training Program of the Army Air Forces is traced, with a description of the apparatus used to train entire crews for large bombing planes. The apparatus simulates in detail the conditions encountered in a night flight, navigation by the stars, a moving representation of the ground, the approach to the target, the bombing run, and the return to base. How all the experiences of an actual bombing mission are carried out with the aid of the equipment is explained. It is stated that the device reduces by as much as 35 per cent the time required to train a pupil, saving money and risks for the students by comparison with actual flights in real airplanes. *Air Facts*, February, 1944, pages 42–46.

The Air Training Corps. Air Commodore Chamier. An article in which the organization, development, and activities of Britain's Air Training Corps are described. A table is provided which gives the details of Air Training Corps tests. *Aeronautics*, January, 1944, pages 46–48.

Teaching Air Photography. John Yoxall. From a visit to the No. 1 School of Photography, the courses and training methods of Royal Air Force photographic schools are recounted. As outlined, the curriculum consists of the following subjects: elementary theory (light, optics, and chemistry) and use of ground camera; negative-making and elementary printing; working of the F.24 camera; use of air cameras for daylight vertical and oblique photography; film development; advanced printing and enlarging from air negatives; cine-camera guns; layout and use of mobile photographic darkroom trailers; night and torpedo cameras; and general work, including such topics as stores procedure, section organization, and negative-indexing. In addition, part of the students' time is devoted to arms drill and physical training. There are refresher and instructor's courses for noncommissioned officers and a comprehensive course for photographic officers which stresses the theoretical rather than the practical.

Methods of grading and examining students are related, service uses of photography are outlined, the division of photographic activities in the Royal Air Force is reviewed, and the employment of multiprinting is noted. Mention is also made of several sidelight features of the school, including its stereoptic photography and museum of German and British courses. *Flight*, December 23, 1943, pages 689–692, 11 illus.

Air WAVES. How women are becoming increasingly important in the U.S. Navy's aviation operations is related in this account of the WAVES. It is noted that it was on March 27,



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Army Air Corps students master the intricacies of the Sperry bombsight at one of the service schools of the Sperry Gyroscope Company.

1943, that the first WAVES were assigned ratings in Naval aviation. Since that time, the Navy has installed or plans to place WAVES in training centers teaching not only instrument flying, but navigation, synthetic gunnery, ship and aircraft recognition, and radio code.

While the first WAVES, and many of those since given aviation ratings, have been trained as instructors, the majority of "Women Accepted for Volunteer Emergency Service" are taking the place of men with aviation ratings as control tower operators, aircraft instrument repair and maintenance mechanics, machinists' mates, metalsmiths, parachute riggers, and weather officers. *National Aeronautics*, January, 1944, pages 18, 19, 54, 2 illus.

Warfare

Strategic Precision Bombing. Lucien Zacharoff. An explanation of the purpose of daylight precision bombing, together with an analysis of its results. The American concept of daylight strategic bomb attack is interpreted as having one main objective: the destruction of the enemy's industrial production facilities and communications network. In contrast, pattern bombing is defined as having the purpose of demolishing cities and disrupting morale.

To illustrate the devastating results of precise strategic bombing, the raid on Schweinfurt is discussed. The author also tells how targets of industrial significance are selected, outlining the factors that are taken into consideration. The ultimate effect of the American plan of precision daylight bombing is regarded as an important part of the strategy. *Southern Flight*, January, 1944, pages 23–25, 44, 46, 4 illus.

Air War's Test Tube. George Johnston. A general review of the role played by aviation in southwest Pacific combat operations. Not only is it emphasized that air domination has proved to be the greatest contributing factor to victories in this area, but it is also stated that the ways in which air power has been employed in the southwest Pacific have set a pattern for future victory on a large scale. Nineteen types of American, British, and Australian planes that have been used in the campaigns are named, with the versatility of some of these planes indicated. *Flying*, February, 1944, pages 30–32, 126, 128, 4 illus.

Fighter Sweeps. By an R.A.F. Officer. An explanation of the offensive air-combat maneuver, termed "sweeps," in which formations of Royal Air Force fighters fly over enemy territory in a challenge for their planes to come out and fight. In addition to destroying enemy installations, it is demonstrated how this air tactic strikes effective blows against morale. A typical mission is outlined. *Flying Aces*, March, 1944, pages 40, 54, 55, 2 illus.

Welding

The Spot Welding of Magnesium Alloys. A research report on the application of spot welding to magnesium alloys. Sections discuss the preparation for welding, the surface treatment of completed assemblies, general requirement for spot welding, spot welding with a.c. equipment and with electrostatic and electromagnetic stored-energy equipment, and the characteristics and properties of spot welds. *The Welding Journal*, December, 1943, pages 633-s–640-s, 16 illus.

Redesign for Welding Saves Valuable Machine Time in Aircraft. R. W. Cripe. A brief description is given of how a boring bar for boring landing-gear struts was redesigned in order to save valuable machine time. Formerly, much time was required to manufacture the bar because of the amount of machinery necessary. The new design calls for 1⅞-s- or 2-in. thick walled tubing, making drilling for an oil hole unnecessary. The cutting tip is built up by arc welding, using tool-steel electrodes. *The Welding Journal*, December, 1943, page 1026.

Applicable Methods of Inspection of Arc Welding of Aeronautical Equipment. J. B. Johnson. Methods of inspecting arc-welded aeronautical equipment for the Army are outlined. A modification of the magnaflux inspection, in which fluorescent powder is used to accentuate the outline of cracks under certain lighting conditions, is described. *The Welding Journal*, December, 1943, pages 1026, 1027.

Quality Control in Aircraft Spot-welding. Nathan C. Clark. Steps that may be taken to assure the highest quality of spot-weld production in the aircraft industry are reviewed. It is shown that of the various procedures considered the practical solution to the problem of quality control of spot-welding production involves three basic requirements: (1) standardization of the equipment and process, (2) the application of statistical control, and (3) monitoring of the spot-welding machines or nondestructive testing of the finished product. The sections on spot-welding machines are devoted mainly to the stored-energy types of equipment. It is stated the features of spot-welding machines most in need of standardization are the controls of (1) energy delivered to the weld; (2) electrode current wave shape; (3) the amount of electrode force; (4) forge time delay, if used; and (5) the shape, surface condition, and life of the electrode tips. Some attention is also given to other matters of standardization. It is pointed out that statistical control, based on the sampling of production and subsequent analysis and prediction of quality, can be used to advantage in a number of ways: measuring the quality of the product, predicting trouble before it occurs, assuring optimum machine performance, and the developing of the most economical specifications for the spot-welding process. The difference between monitoring and nondestructive testing is explained, and several proposed methods of accomplishing each of these are discussed. It is then shown that even the best possible standardization is only a close approach to perfection and, therefore, that at least slight variations are certain to occur. Statistical control is essential for the maintenance of high consistency and adequate strength of spot welds and as a means of fairly measuring the quality of production, and monitoring is required for positive

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proof of the strength of individual spot welds as they are produced.

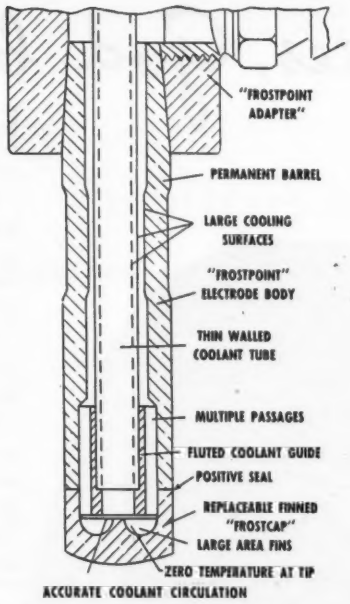
An appendix, explaining the meanings of certain statistical parameters as applied to quality measurements of spot-weld production, is included. *The Welding Journal*, January, 1944, pages 48–59, 7 illus.

Spotwelding Expedites Lockheed "Constellations." Ellis F. Gardner. A survey of the spot-welding applications used in the fabrication of the Lockheed Constellation's primary structures. In addition to relating the techniques employed, the article lists the design and production advantages that are derived through the utilization of single spot-, roll spot-, and seam- or overlapping spot-welding procedures. Structural applications described include the spot welding of fuselage skin panels, outer wing panel assemblies, stub and inner wing beam webs, and power-plant components. Certain other applications to secondary structures are mentioned. *Aviation*, January, 1944, pages 161–165, 363, 364, 16 illus.

Contact Resistance Measurements as Control for Preweld Cleaning of Aluminum Alloys. G. W. Scott, Jr., and E. B. Charles. This article covers the measurement of the contact resistance between aluminum-alloy test specimens that have been employed for over a year as a production control of cleaning solutions used prior to spot welding. A description is given of the apparatus employed and of measurement technique. Optimum immersion times, as obtained from resistance measurements taken from a set of cleaning curves derived by plotting average contact resistance against immersion time, are given. *The Welding Journal*, January, 1944, pages 1-s–7-s, 15 illus.

Correlation of the Strength and Structure of Spot Welds in Aluminum Alloys. F. Keller and D. W. Smith. It is shown that the use of spot welding for assembly of aluminum-alloy structures would undoubtedly be extended by the development of some suitable method for checking the quality and strength of spot-welded joints. Several nondestructive testing methods now being investigated are mentioned. The radiographic method, which is stated to appear most applicable for determining the characteristics of the weld nugget and for estimating the shear strength of the joint, is the chief subject of discussion. Radiographic images of spot welds are shown. One table gives the estimated and actual shear strength of spot welds made in 0.40-in. Alclad 24S-T sheet with alternating current, using 3-in. radius tips and 1,000-lb. tip pressure. A second table gives similar data using the energy storage method. *The Welding Journal*, January, 1944, pages 23-s–26-s, 13 illus.

Fatigue Studies of Weld Test Triangular Structures with NE8630 Steel Tubing. A. J. Williamson. Fatigue tests on welded tube triangles for aircraft structures made from NE8630 steel are described. The results of the tests are tabulated and discussed. The study resulted in the following conclusions: (1) Sufficient points in fatigue testing were established and indicated little difference to the fatigue value for as-welded, tempered-after-welding, and normalized-after-welding test triangles. The highest fatigue value (where the curve becomes horizontal) is 12,500 lbs. per sq.in. for the tempered-after-welding specimens. (2) There was indicated some correlation between welding defects—such as blisters, burning through, craters, etc.—and fractures, although this was by no means conclusive. (3) Failure could not be attributed directly to the high hardness in the heat-affected zone. (4) Failure invariably occurred at the junction of the weld bead and tube wall or at the point of highest stress concentration. (5) Obviously, there is no correlation between fatigue life and tensile strength, but factors of "notch effect" appear to be the dominating influence in this investigation. (6) It would appear that the question of joint assembly or design plays the most important part in the fatigue life of structures such as were tested in this investigation. (7) Fatigue values are low, indicating that a question can be raised as to why a steel of such high tensile strength should be used if fatigue is the only factor. *The Welding Journal*, January, 1944, pages 27-s–32-s, 14 illus.



A diagrammatic drawing of the "Frostpoint" electrode, manufactured by Frostrode Products. Improved quality of welds and an increase in the number of welds obtained between electrode dressings are two of the results reported from the use of this refrigerated electrode.

Fatigue Strength of Welded Aircraft Joints. T. V. Buckwalter and O. J. Horger. A report of fatigue tests made on welded triangular structures and copper- and silver-brazed sleeve joints made from steel aircraft tubing. Oxyacetylene pressure welded joints of 2-in. diameter were also investigated in rotating bending. Sections of the paper describe the design of the fatigue specimens and the method of testing them. The results of these fatigue tests are tabulated and discussed. *The Welding Journal*, January, 1944, pages 50-s–58-s, 23 illus.

Miscellaneous

Spreading Air News. An account of how the Public Relations units of the Royal Air Force operate in the field. The activities of the Public Relations officers in sending news to the press are illustrated by following a hypothetical incident from the time it occurs on the Italian front until it is published in London. Their system of bringing press representatives to the news is described by recounting a recent trip that 14 air correspondents made to the Mediterranean theater of air operations. A diagrammatic layout of the P.R.O. units in the Mediterranean Air Command accompanies the article. *Flight*, December 2, 1943, pages 606–608, 7 illus.

Industry's Scientific Groups Analyzed. E. J. Foley. Consideration is given to the value and future of the professional organizations of the aviation industry. The writer suggests that the multitude of professional societies may be a phase of aviation adolescence—a passing peak period that will be stabilized ultimately at a lower level. *American Aviation*, January 15, 1944, page 74, 1 illus.

How Good is Axis Equipment? Beryl D. Kneen. Some examples of the information culled from the testing of Axis equipment at Aberdeen Army Proving Grounds and Matériel Command headquarters at Wright Field. Included in the report are conclusions about the Zero, the Messerschmitt 109F, the artificial horizon used by the Germans, the German radio-directed rocket bomb and aerial rocket gun, the German 88 antiaircraft gun, and miscellaneous ordnance equipment developed by the Germans, Italians, and Japanese. Two prime objectives are ascribed to this testing of enemy equipment: One is to familiarize the American soldier with enemy weapons and remove his fear of them; the other is to determine as far as possible how the enemy's supply and manufacture of the weapons is progressing. *Flying Aces*, March, 1944, pages 22, 23, 65, 66, 5 illus.

Microgram Service. This article covers the transmission of mail by photographic means and the use of this system by British governmental and service agencies. It calls attention to the fact that the Microgram Service is employed for the expeditious transmission of official documents and the requisitioning of spare parts, as well as for hastening civilian and Service correspondence. The development of equipment for photographing and reprinting the letters is reviewed, with details regarding the Williams Multiprinter and Microprinter machines—the former used by the R.A.F., and the latter by the General Post Office. *Flight*, December 2, 1943, pages 616, 617, 3 illus.

To the ladies, God bless them!

HERE YOU SEE a force that Hitler and Tojo sadly misjudged — *American womanpower.*

Day and night, throughout the U.S. aircraft industry, women by the thousands are working to upset the Axis applecart. Women who were stenographers, home-bodies, salespeople . . . the girl next door . . .

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Government Publications

Army Air Forces

Why That Target? Capt. Luther Davis. A review in narrative style of the functions of the Combined Chiefs of Staff in directing the total efforts of the United Nations shows how even the smallest incident may have a part in a well-developed campaign. Information about how the master plan is worked out by the top officials in Washington and how the various divisions of the organization carry out their individual assignments is included. Although it may be difficult for civilians or lower-ranking officers to understand the relationship of a bombing mission to the plans for action by ground troops or naval units many miles distant, it is probable that every detail has an important bearing upon the major strategy. A chart shows how orders are channeled from the central office to the tactical units. *Air Force*, February, 1944.

This is Your Enemy. A photographic copy of a captured German drawing of a B-17 is shown. This diagram indicates the plane's fire power, location of guns, and their maneuvering range, fuel tanks, and armored points. It is stated that the Germans have formed special units that fly captured B-17's, engage in mock battles with German fighters, and attempt to work out new tactics that will give their fighters more of a chance against the American bomber. *Air Force*, February, 1944.

New Trigger-Nometry. The development of the system called "position firing," by which the gunner's deflections are figured out for him in advance, is described. The system is based on speed, course, air density, deflection, and many other factors. It is noted that despite these calculations it is much simpler and more accurate than older sighting methods. An outline is given of the ways of teaching the new systems of gunnery. *Air Force*, February, 1944.

Filming the Air War. Capt. Carl Dreher. An account is given of how the Army Air Forces obtain motion pictures to study world-wide combat operations. *Air Force*, February, 1944.

Design Standard No. 215 was approved in January, 1944. It contains a drawing and tabulated specifications for plain or friction bell-crank bearings made of steel or aluminum alloy.

Revised Standard No. 372 covers self-locking nuts with fine or coarse threads. *Army Air Forces, Matériel Command.*

Bureau of Aeronautics

Instrument Flight. Part I. This pamphlet on instrument flying is one of a Basic Air Work series. Its purpose is to show the student that instrument flying is as logical and easy as contact flying. Chapters cover the attitude and "1-2-3" systems, the aerodynamics of straight flight, the instruments used, and the analysis of maneuvers. *Training Division*, $0.35.

The Aeronautical Board

New Army-Navy Aeronautical Specifications have been approved by joint action of the War and Navy departments for use in procurement of aeronautical supplies and shall become effective at specified dates or upon issue of the applicable ANA Bulletins. A current list follows: AN-A-10a, clad aluminum alloy, sheet and strip; AN-P-11, engine-driven hydraulic pumps; AN-T-11a, aerial navigation beacon tower; AN-S-43, process for splicing cable terminals.

Amendments to Army-Navy Specifications have been issued as follows: AN-F-10 Amendment-1, aircraft flotation equipment rubberized fabric; AN-JJ-W-154 Amendment-4, cotton elastic webbing; AN-T-8b Amendment-2, toluene substitute thinner; AN-T-28 Amendment-1, blush-retarding cellulose acetate butyrate dope thinner; AN-TT-T-258 Amendment-3, blush-retarding cellulose-nitrate-dope-and-lacquer thinner; AN-TT-T-V-116 Amendment-2, glyceryl-phthalate spar varnish; AN-TT-T-256 Amendment-4, cellulose-nitrate-dope-and-lacquer thinner.

ANA Bulletin No. 101b refers to Specification AN-TT-E-501 covering black, heat-resisting, glyceryl-phthalate enamel. It contains the list of enamels considered acceptable under the specification indicated. The tabulation shows the name and address of the manufacturers, the AN Code numbers and the corresponding manufacturers' formula numbers.

The monthly *Numerical List of Army Air Forces and Army-Navy Aeronautical Standard Parts* shows items approved primarily for use in the maintenance and construction of aircraft. The list is marked to indicate new and revised sheets made available since the last issue of the list; standards that are inactive for new design or procurement or have been canceled; and standards that are "Restricted."

Army-Navy Aeronautical Standards sheets have been issued, giving new or revised specifications on items as follows: continuous hinges, nuts and rivets of various types, hose clamps, tee-flared tube, cable assemblies, generator-control switches, engine-primer pumps, instrument lamps, and remote electrically operated caging-drive flexible shafts for gyro flux gate compass. Other materials on which new or revised sheets are in effect include vacuum-control instrument valves, engine-driven air pumps and hydraulic pumps, and packing-gland ring wipers.

Army-Navy Aeronautical Design Standards sheets cover limitations for usage of self-locking nuts and plate nuts and design requirements for carburetor screens and gaskets.

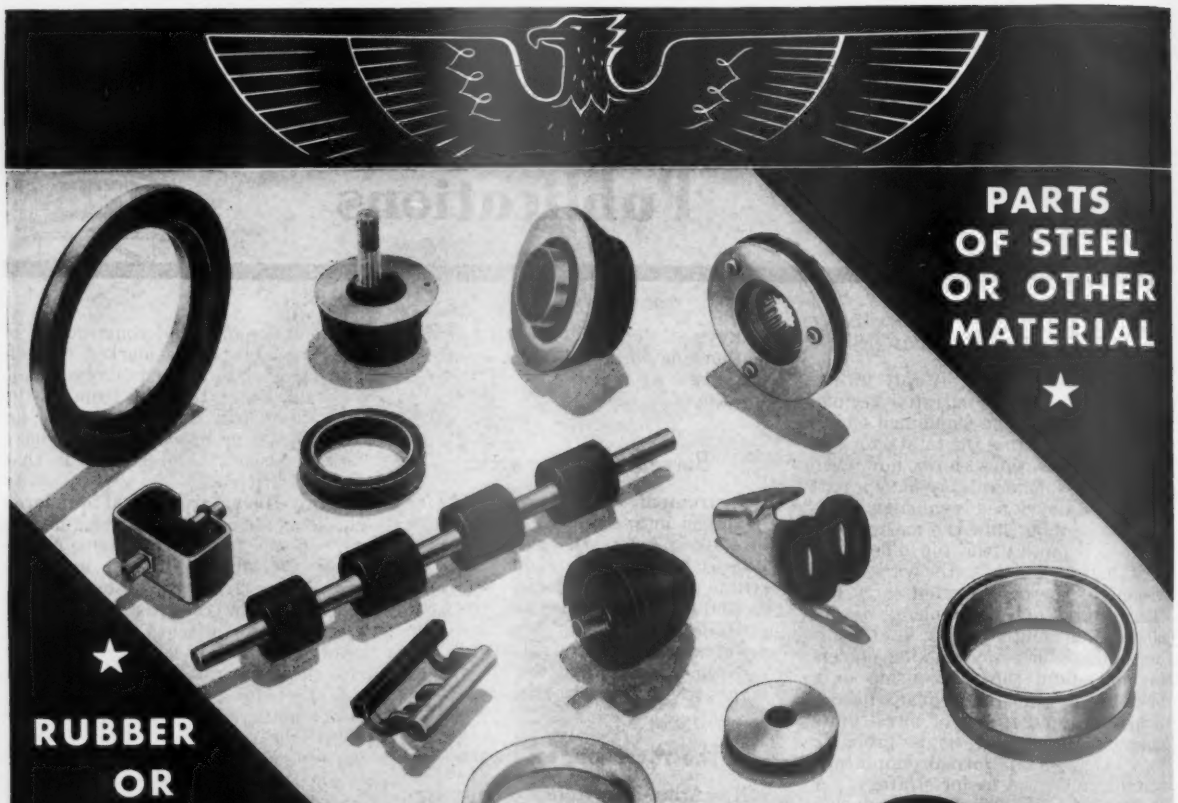
An alphabetical index of standard aeronautical materials and fittings and the regular monthly index of Army-Navy Aeronautical Standards are available.

Aircraft Production Board

Magnesium Time Cycle Charts as Aids to Ordering Procedure. The Materials Distribution Branch has prepared for the Aircraft Scheduling Unit, with the assistance and cooperation of magnesium producers and fabricators, four magnesium-alloy time cycle charts on castings, forgings, sheet, and extruded products.

In the past, magnesium for fabrication has been allocated monthly by the Aluminum & Magnesium Division of the War Production Board on the basis of requirements submitted by aircraft contractors to A.S.U. and approved by A.S.U. This procedure served the purpose of channeling the inadequate supply of magnesium ingot into those uses that the services considered to be of first importance.

With the improved magnesium ingot situation and increased demand for magnesium-alloy fabricated products, A.S.U. and W.P.B. have cooperated in simplifying magnesium procurement and distribution procedure. The existing forms for requesting



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allotment have been eliminated, and requests are currently made on Form WPB-3462, which applies to consumers who use magnesium products for nonaircraft purposes, as well as those whose output is for aircraft.

Details of the manner in which the new procedure will function are shown graphically in the charts. The chart, *Time Cycle for Procurement of Typical Aircraft Magnesium Alloy Sand Castings Over Five Pounds* presents the procurement cycle for castings and regulations governing the distribution of all fabricated magnesium-alloy products. The wrought products (alloy plate and sheet, extrusions, and forgings) charts show only the total time lapse from the placing of purchase order to shipment. Form WPB-3462 must be submitted at least 10 weeks prior to the delivery month for all forms of magnesium. Although the filing date of Form WPB-3462 for magnesium forgings is the same as for other products, the time cycle for procurement and fabrication is about 3 weeks longer. Therefore, in order to be assured magnesium-forging deliveries, contractors should file Form WPB-3462 at least 3 weeks prior to the closing filing date.

The Magnesium Sub-Unit of the Materials Distribution Branch at Wright Field, operating as a service organization for A.S.U., is prepared to assist contractors in obtaining delivery of critical magnesium products, but manufacturers can forestall their own shortages by taking into account the time cycles and delay factors in placing their orders. Manufacturers desiring copies of the time-cycle charts may secure them by writing to the Aircraft Scheduling Unit at Wright Field, Dayton. *Aircraft Scheduling Unit, Aircraft Resources Control Office, Aircraft Production Board.*

Civil Aeronautics Administration

CAA Develops Devices for Testing Pilots' Aptitude. A brief description is given of a pilot-testing device that combines a recording on magnetized wire of the examiner's spoken observations with a continuous film of dial action on the instrument panel. It provides an objective method of verifying a student pilot's ability.

It is stated that the device is now being used at five midwestern universities to instruct pilots for the armed services under C.A.A. War Training Service contracts. *Civil Aeronautics Journal*, January 15, 1944.

Meteorology for Pilots. B. C. Haynes. This is the second edition of a publication covering the ground instructors' courses of the C.A.A.'s War Training Service. The book is prepared especially for pilots and is designed to give the student pilot a sound background in meteorological theories and practices. This edition

brings the student abreast of developments in meteorology which have occurred since the publication of the first edition. New chapters have been added dealing with aviation weather, weather for flight plans, and analysis of the surface weather map. *Civil Aeronautics Bulletin No. 25*, January, 1943. For sale by Superintendent of Documents, Washington, D.C., $0.75.

ANC-17 "Plastics for Aircraft." For the information of the aircraft industry and other interested parties, the ANC Technical Subcommittee on Plastics, under the guidance of the Army-Navy-Civil Committee on Aircraft Design Criteria, has prepared a new ANC publication, ANC-17, "Plastics for Aircraft."

Its primary purpose is to assist airplane designers in the application of plastics materials to aircraft design. The many inquiries received from airplane manufacturers requesting information on the use of plastics have indicated the need for a publication of this nature. Chapters cover nomenclature, general information on plastic materials and processing, properties of plastics, molding and fabricating, typical applications, and specifications and bibliography.

It is expected that the bulletin will be placed on general sale at the Government Printing Office, Washington, D.C. A notice will be inserted in the *Civil Aeronautics Journal* advising when ANC-17 is available at the Government Printing Office. *Safety Regulation Release No. 156*, November, 1943.

Amendment No. 1 to ANC-1 (2), *Chordwise Air-Load Distribution*, has been issued by the Army-Navy-Civil Committee on Aircraft Design Criteria. The most important changes covered by Amendment No. 1 consist of the following: (1) Fig. 3-6 on page 3-12 has been changed to give a better approximation of the actual air-load distribution near the hinge of airfoil flaps; (2) table E-1 on page E-5 has been extended to include flap-chord ratios more closely applicable to tabs.

Engineers interested in this particular subject may obtain copies of the amendment by addressing requests to the Chief, Publication and Statistics Division, Civil Aeronautics Administration, Washington, D.C. *Safety Regulation Release No. 158*, January, 1944.

National Advisory Committee for Aeronautics

Profile Measurements During Cavitation. O. Walchner. Translation of "Profilmessung bei Kavitation," from reprint of paper presented before the Congress on Hydromechanical Problems of Ship Propulsion at Hamburg, May 18 and 19, 1932. Experiments made to determine the wing loads on airfoils during cavitation are reviewed. The apparatus used in the experiments is described and the methods followed in making the tests are outlined. The three different types of cavitation phenomena observed are: (1) Suction-side cavitation starts at the leading edge, when the forward stagnation point lies on the pressure side and when the lowest pressures, on the suction side, caused by flow from the pressure side around the leading edge, occur directly at the leading edge. (2) Suction-side cavitation starts at profile center when the forward stagnation point lies on the leading edge itself, so that the water flows smoothly over it. Likewise, suction-side cavitation of case 2 can form only if the forward stagnation point lies on the suction side. (3) Pressure-side cavitation starting from the leading edge occurs only when the forward stagnation point lies on the suction side and when the flow around the leading edge comes from the suction side. Each of these cases is explained. The lift-drag coefficients are tabulated. *N.A.C.A. T.M. No. 1060*, January, 1944.

An Experimental Investigation of the Flow of Air in a Flat Broadening Channel. A. W. Vedernikoff. Translated from *Report No. 137* of the Central Aero Hydrodynamical Institute, Moscow, 1926. The paper deals with diffusers in wind-tunnel design and contains data obtained from experiments conducted by the Aerodynamical Laboratories of the Central Aero-Hydrodynamical Institute. Because of the complexity and diversity of the factors that appeared simultaneously in earlier experiments, making it difficult to reach any conclusion regarding the optimum shape of the diffuser, it was decided to experiment on a two-dimensional diffuser model to determine the effect of the angle of divergence, the flow distribution, eddies, etc. A description is given of the model used and of the methods followed in the studies. The mathematical problems are worked out and the results are presented in 18 tables. Numerous drawings, charts, and photographs are appended. *N.A.C.A. T.M. No. 1059*, January, 1944.

National Research Council

National Research Council Organization and Members 1943–1944. An index to the organization and membership of the National Research Council for the year 1943–1944 has been published. Following general

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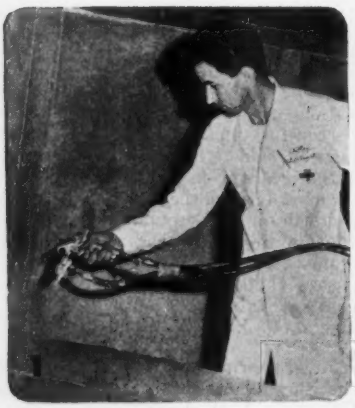

In making a negative "plate," white lacquer is sprayed on ARMCO PAINTGRIP sheets. They are then coated with a fluorescent lacquer, followed by a light green "masking" coat. When the template design is made, lines scribed into the fluorescent base coat result in a fluorescent outline of the pattern when it is activated by X-Rays.

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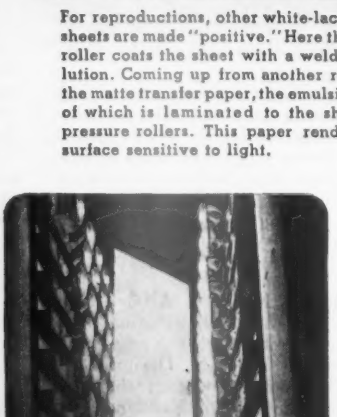
The operator is removing the positive template print from the developing solution. Ordinary photographic chemicals are used in this process, after which the image is fixed in a hypo bath.



When the positive template print has been developed, fixed and washed, it is passed between two banks of infra red lights. In 45 seconds it is completely dry and is sent to the Loft department for use in the production of parts and tools for America's air forces.

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information about the Council, the officers and executive board are listed. The organization of the various Council divisions are then outlined. These include the divisions of: Foreign Relations, Physical Sciences, Engineering & Industrial Research, Chemistry & Chemical Technology, Geology & Geography, Medical Sciences, Biology & Agriculture, and Anthropology & Psychology. National Research Council Fellowships and awards are reported,. and the book concludes with two alphabetical lists: one of the Council's personnel and the other of its divisions and committees.

Navy Department

The International Code of Signals, American Edition, Volume I, for Visual and Sound Signals. A 1943 reprint of this code book contains instructions for signaling by visual and sound methods, according to agreements made at international conferences at Washington in 1927 and at London in 1930. After introductory chapters covering definitions, methods of signaling, and general instructions, the chapters give specific directions for: signaling by flags; Morse signaling; signaling by flashlight; signaling by sound; and signaling by semaphore. The concluding chapter contains explanations and instructions for use, and appendixes cover ship and aircraft distress signals, pilot signals, quarantine signals, and towing signals. Another appendix includes information concerning storm warnings, the naval communication service, Hydrographic Office publications, weather codes, instructions to mariners in case of shipwreck, and Coast Guard districts and stations in the United States. The lifesaving organization on the coast of the United Kingdom also is described. *H. O. No. 87;* 362 pages. For sale by the Hydrographic Office, Washington, D.C., and also by the Superintendent of Documents, Washington, D.C., $2.25.

Radio Navigational Aids 1943. The present edition of this book has been extensively revised and an appreciable amount of new information has been incorporated. It contains general information and lists of stations rendering radio services to navigators other than weather broadcasts. It is divided into chapters according to the nature of the service performed by the radio stations. Each chapter contains, first, general information on the service rendered, and, second, the list of stations. The first numeral (hundreds digit) of section numbers of text and the first numeral (thousands digit) of station numbers correspond to the chapter number. In each chapter the stations are arranged, in general, in geographical order so that the mariner may readily determine which of several stations in his vicinity renders services most suited to immediate needs. Chapter 7 contains regulations on the use of radio in territorial waters. Chapter 8 gives the International Morse Code and conventional signals. The index to countries follows immediately after the table of contents. After each country there is listed the nature of the radio services that it renders to navigators. In the index to radio stations at the back of the volume, the stations are arranged alphabetically and the nature of the services they render is indicated. *H. O. No. 205,* 330 pages. For sale by the Hydrographic Office, Washington, D.C., $0.90.

War Department

Jet-Propelled Aircraft. In a joint U.S. Army Air Forces-British R.A.F. statement, issued by General H. H. Arnold, Commanding General of the A.A.F., it is revealed that the jet-propelled fighter aircraft have passed experimental tests successfully and soon will be in production.

Jet-propulsion engines were originally of British design. Work was started on these engines in Great Britain in 1933 by Group Capt. Frank Whittle. His preliminary engine ran successfully in April, 1937. The Air Ministry placed its first order for an aircraft using jet-propulsion engines in 1939 with Gloucester Aircraft Company, Ltd., Gloucester, England. The engines were to be built by Power Jets, Ltd., in a special factory in England to whom Group Captain Whittle was loaned. The first successful flight of this aircraft was in May, 1941.

Full information about this jet-propulsion engine was disclosed in July, 1941, to the U.S. Army Air Forces. The U.S.A.A.F. at once asked for an engine to be sent to the United States, and the engine that had made the first flight was sent to the General Electric Company in September, 1941. As the result of close cooperation between the U.S. Army Air Forces, the Royal Air Force, the A.A.F. Matériel Command, the Ministry of Aircraft Production, and the General Electric Company, a number of these engines were built.

The first of these engines was ready for test in less than 6 months. At the same time the Bell Aircraft Company was given an order to build an aircraft suitable to operate with two of these engines, and the first flight in the United States was made in less than 12 months. Several hundred successful flights have been carried out since then by American pilots in the United States and by British pilots with the British aircraft in England, many of them at high altitudes and extreme speed and all without a single mishap.

In view of this successful record and the obvious advantages of this new type of aircraft, General Arnold and the British Air Ministry and Ministry of Aircraft Production have directed that plans be made for the production of a sufficient quantity for training purposes both in the United States and in Great Britain. The U.S.A.-A.F. is allotting a number of these to the U.S. Navy for additional trials and experimentation.

The initial flight of the first experimental aircraft in the United States took place October 1, 1942. This was the first successful operation of a combat plane using the jet-propulsion principle. Robert M. Stanley, Chief Test Pilot of the Bell Aircraft Company, was at the controls on the initial flight. The next day, Brig. Gen. (then Colonel) Laurence C. Craigie flew the aircraft, thus becoming the first Army officer to fly a jet-propelled military aircraft in the United States. Among others who have tested the new aircraft are Brig. Gen. B. W. Chidlaw, Chief of the Matériel Division, Office of the Assistant Chief of Air Staff, Matériel, Maintenance and Distribution; and Major Gen. William E. Kepner, a veteran Air Corps fighter pilot, formerly commanding the Fourth Air Force. In Britain the airplane has been flown by a number of test pilots of aircraft firms and by R.A.F. officers. *Bureau of Public Relations.*

Index of United States Army and Federal Specifications Used by the War Department. This book contains alphabetical and numerical lists of approved Army and Federal specifications used by the War Department, covering such commodities as are usually purchased by agencies of the War Department. Federal specifications, when issued, cover commercial materials and articles common to two or more departments or independent establishments of the Federal Government. Federal specifications are not shown in the numerical section of this index. For sale by the Superintendent of Documents, Washington, D.C., $0.30.

List of Publications for Training. The three sections of this booklet contain lists of current publications for the instruction of Army personnel. Section 1 lists the Field Service Regulations, Field Manuals, and Technical Manuals. Section 2 covers the scope, numbering, and distribution of Training Circulars, and Section 3 includes lists of printed publications. *Basic Field Manual FM 2-16,* 24 pages, $0.20.

List of Training Films, Film Strips, and Film Bulletins. This manual describes the visual-aid facilities furnished by the War Department and explains how they are intended to be used and how they are made available for use. The films and other materials are tabulated in numerical order, followed by a list in alphabetical order. *Basic Field Manual FM 21-7,* 280 pages, $0.35.

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both ground and air, are discussed. The chapters include general instruction and specific information concerning concealment, scouting and observing, antiaircraft protection, antimechanized protection, protection against chemicals, protection of military information, and protection against carelessness. The text matter is supplemented by sketches. *Basic Field Manual FM 21-45*, 154 pages, $0.25.

Elementary Weather for Air Crew Trainees. Sections of this manual are devoted to general information about the importance of weather to flying, safety in flying, and the weather services available for military aviation. This is followed by sections on airway weather observations and reports, weather maps, and winds aloft. A chart is included giving an explanation of symbols and weather reports, as well as a chart of weather-map symbols. *Technical Manual TM 1-231*, 23 pages, $0.10.

Training Film and Film Strip Projection. The purpose of this booklet is to provide instruction for the correct use, maintenance, and storage of training film and projection equipment. Its sections give information about the equipment and instructions for the employment of the equipment, its care, handling, and maintenance. Other sections refer to the film-strip projector, giving general information and instructions for operation and replacement of parts. Appendixes include screen tables, trouble charts, parts list, and the names and addresses of manufacturers. *Technical Manual TM 11-401*, 82 pages, $0.15.

Aircraft Woodwork. The information included is to be construed as of a general nature and should not be regarded as a substitute for specific instructions in Technical Orders, specifications, manufacturers' handbooks, or other authoritative sources. The manual is intended for use as a guide in the repair and maintenance of aircraft employing wood as a structural material. Sections cover the characteristics of wood, lumber and plywood, glue and hardware, hand tools, woodworking machines and operations, and the construction and repair of wooden aircraft. Numerous illustrations include figures and drawings showing construction methods and tools. *Technical Manual TM 1-414*, 148 pages, $0.20.

Mathematics for Air Crew Trainees. A review is provided of some topics of mathematics and related material which the air crew trainee must understand. The first seven sections include the elementary operations of arithmetic, such as addition, subtraction, multiplication, and division; per cent, ratio and proportion; algebra; angular measurements; scales; the use of graphs and formulas; and the graphic solution of the more common problems involving the triangle of velocity. Sections VIII to XIII, inclusive, provide additional instruction ma-

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terial for the required mathematical background of air crew trainees who are to qualify as pilots, navigators, and bombardiers. Appendixes cover formulas, conversion factors, and tables of logarithms and trigonometric functions. *Technical Manual TM 1-900*, 176 pages, $0.15.

Fundamentals of Mechanical Drawing. This manual is intended to familiarize the student mechanic with the basic principles of mechanical drawing and general practices relevant thereto. Only subject matter considered essential for use in basic courses in mechanical drawing has been included. Sections of the manual cover the equipment and materials; lettering and lines; geometric constructions; orthographic projection; pictorial drawing, sectional views and threaded parts; scales, dimensions, and notes; technical sketching; sheet-metal drafting; and representative working drawings. Numerous drawings supplement the text matter. *Technical Manual TM 1-1450*, 90 pages, $0.15.

The foregoing manuals are for sale by the Superintendent of Documents, Washington, D.C., at the prices noted.

War Production Board

Handbook of Definitions of Materials and End Products. Intended primarily for the use of those agencies in the Navy Department charged with design, specification, requisition, production, inspection, and salvage of Navy materials, this book contains official definitions of materials and end products specified in the "M" and "L" orders issued by the War Production Board through March 1, 1943. The two classifications of orders are treated individually in separate sections, with the definitions under "M" orders referring mainly to materials, while those under "L" orders principally cover finished products. Definitions in each section of the book are listed in alphabetical order. The term defined is given first and is followed by the W.P.B. order number and title in which the definition is initially used. The definition is then cited as stated in the last amendment to the order, if any, as of March 1, 1943. Where several definitions of the same material or end product appear in different orders, each definition is given separately under the corresponding W.P.B. order. Cross references are provided. Prepared under the direction of Consumer Standards Section, Food Distribution Administration, U.S. Department of Agriculture, in collaboration with Material Section, Conservation Division, Production Branch, Office of Procurement and Material, U.S. Navy Department.

Inspection and Repair of Respirators and Oilskin Clothing and Decontamination of Respirators. This fourth edition of a pamphlet is one of a series on air-raid precautions. *Ministry of Home Security Memorandum No. 13*, $0.10.

First Aid and Nursing for Gas Casualties. The second of a series of Air Raid Precautions handbooks. The book contains the general and technical information required by nurses and by first-aid personnel to enable them to carry out their respective duties. *The Ministry of Home Security and The Ministry of Health*, $0.10.

(*Continued from page 65*)

at the equator where the rotor shaft is parallel to the earth's axis and 15° per hour at the poles where the rotor shaft is 90° from the axis of the earth. Correction can be made for a given latitude —as, for example, 45° north—but the error is then doubled at 45° south latitude. Correction is made by moving a small adjusting weight, and it is not difficult to change the setting to obtain compensation for the latitude in which the instrument is to be used.

The directional gyro is equipped with an antitumbling device that maintains the gyro motor in a perpendicular relationship with the vertical gimbal so as to set up a maximum of safe operating range available for maneuvering of the aircraft. In the electrical design a simple means is employed. Gyroscopic theory dictates that torque about one axis of a gyro normally produces precession about a perpendicular axis; however, if that precession is resisted, the precession is reflected back into the axis initiating the torque. By properly balancing the centering torque contributed by the spirals about the motor axis and the counter-friction torque about the vertical axis, the perpendicular relationship between the motor and vertical gimbal may be maintained.

Caging Mechanism

Both the horizon gyro and directional gyro are equipped with caging mechanisms to hold the delicate gyro elements to prevent damage resulting from acrobatics of the aircraft beyond the limits of freedom of the devices. The caging mechanisms also allow the pilot to reset the instrument to its normal operating position. In the case of the gyro horizon, the pilot may level his aircraft and uncage the instrument, thus saving the erection time necessary for the instrument to right itself. In the case of the directional, the pilot, by caging and turning the caging knob, may rotate the gyro element to any position of reference he desires.

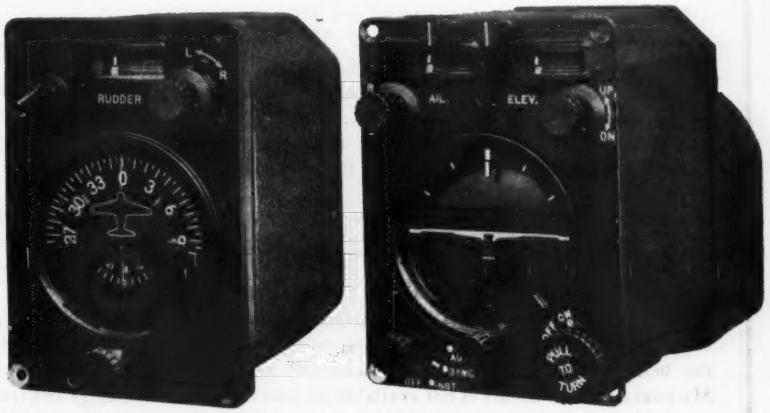

FIG. 8. Directional gyro and gyro horizon equipped with pick-offs, potentiometer controls, and synchronizing indicators to serve as the "brains" of an automatic pilot.

Adaptability to Control

Electrically driven gyros lend themselves conveniently to interconnection for automatic control such as required in the automatic pilot. Fig. 8 illustrates a gyro horizon and a directional gyro that have been equipped with induction type pick-offs for this purpose. It was possible to incorporate into the instruments themselves the necessary controls and indicators for synchronizing and adjusting trim and sensitivity.

Conclusion

Electricity has brought to small gyroscopic instruments increased reliability and improved accuracy under extremes of temperature and altitude. It permits sealing of the case to protect the sensitive mechanism from dirt and corrosive fumes and thus prolongs the life of the instrument by preventing bearing wear due to grit or loss of lubrication. The ability to remove the cover with the operating mechanism intact aids in locating trouble and simplifies overhaul and adjustment.

The present trend is toward complete electrification of aircraft, eliminating, to a large extent, the pneumatic and hydraulic systems now commonly used. Electrification of the gyroscopic instruments is a necessary part of this program.

Services of the Aeronautical Archives of the Institute of the Aeronautical Sciences

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The Pacific Aeronautical Library

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Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

The Aeronautical Archives Technical Information Service

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports, and general surveys of any aeronautical subject. Some of the available services are:

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In addition to the services mentioned any commission which comes within the scope of the Service will be accepted. Special arrangements may be made for work requiring several weeks or months.

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This Flying Game

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This new edition of a popular book will be welcomed, for it brings the chapters up to date and reflects the experience gained by the authors since they became two of the most famous air generals in the world.

The first section of the book gives a history of aviation and famous flights. From there on those who have not read the earlier editions will find probably the clearest exposition that has been written of the part the air forces play in warfare. The chapters describe the training of military pilots, naval aeronautics including airships, civil aviation, and the lessons from the air in Spain, China, and in Europe.

The book is authoritative and has the great advantage of having been written before the war. It is presented now with the experience of leadership in the first two years of war. Funk & Wagnalls Company, New York, 1943; 323 pages, $3.00.

Medical Aspects of Aviation

Capt. Ernst Jikl

Usually, books on aviation medicine use terms that are not understood by the layman or the average pilot. This book is written so that it will be of the greatest service to any airman, even though he does not know medical terminology.

It limits its field to the physiologic effects of speed and acceleration. By means of many excellent drawings, the text is amplified and made clear. It is a book that will put any pilot on his guard against situations that may have tragic results if he neglects to exercise special caution. As many of the effects of speed and acceleration are not felt physically until it is too late to avoid them, such warnings as are given in the book should be heeded by every airman. Sir Isaac Pitman & Sons, Ltd., London, 1943; 104 pages, $3.00.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Victory at Midway

Lt. Comdr. Griffith Baily Coale

The author is an artist and a writer who volunteered as a combat artist for the Navy in 1941. He saw active service before Pearl Harbor and therefore has an informed background when he describes the first United States decisive victory in this war.

The illustrations, which are made from paintings by the author, follow the sequence of the text and give first-hand pictures of the naval and air engagements. As the author was an eyewitness, the book has a personal quality that will recommend it. His account of the Battle of Midway, which is preceded by his previous experiences at sea, is a vivid description of this aerial victory in which the warships never saw the enemy fleet and convoy. Farrar & Rinehart, Inc., New York, 1944; 178 pages, $3.00.

An Educational Guide in Air Transportation

Prepared by Ralph E. Hinkel and Leo Baron

Prepared primarily for educators and students, the book contains complete descriptions of the types of jobs available in commercial transport, together with vocational charts setting forth qualifications and salary ranges. It includes a world map and explains that the airplane has caused us to place the North Pole at the center, much in the way that the hub is in the center of a wheel.

It describes how global war has brought a three-dimensional age of the air and outlines the limitless possibilities of aircraft in commerce.

In addition to an orientation course in air transportation, the educational guide contains a bibliography on various aviation subjects. Transcontinental & Western Air, Inc., Kansas City, Mo., 1943; 140 pages, $0.75.

Air Training Manual

Contents: Modern Flight; Refresher Course in Mathematics; Aero-Engines; Aircraft Instruments; Electricity and Wireless; Airframe Construction; Soaring and Gliding; Air Navigation.

The broad claim is made that this manual provides a complete course of instruction for those young men who are about to enter the English Air Training Corps. The reader will naturally expect to find an encyclopedic work. Although it has chapters on a broad field, each written by a specialist in his subject, much of the manual is devoted to refresher courses in mathematics, electricity, and simplified mechanics. The result is that the book will be a useful guide to a knowledge of aircraft instruments, power plants and construction, radio, air navigation, and gliders.

It will be equally useful for the air-minded young man who wishes to understand the fundamentals of aeronautical engineering and design. By the use of small type to conserve paper, a larger amount of text is available than in the usual large type pages. It is a book that, if available in the United States, would give an excellent idea of English construction and operation of aircraft. The illustrations are well drawn and add greatly to the descriptive test. Odhams Press Limited, London, 1943; 320 pages, 7*s.* 6*d.*

Our Airlines—Our Lifelines

Bruce Elliott

Contents: The Problems to Be Faced; Back Log 1917–1937; The Storm Bursts; Our Competitors; Our Resources; Great Britain and Europe; World Air Routes—The International Aspect; Air Traffic After the War; Economics of Civil Aviation; Air in Relation to Sea Transport; Airlines and Airports of the Future; Air Transport and the Government.

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Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

British air transport and showing how it was stifled by bureaucratic control, the author describes the great expansion of the British Overseas Airways Corporation, which has 14,000 employees and operates 85 trunk air lines. This expansion took place using "only the 'scraps' from the large numbers of aircraft coming over to this country from America for the R.A.F." With these additions the B.O.A.C. doubled its miles flown.

The backward state of British airliner construction is admitted, but it is predicted that the B.O.A.C. may expand after the war to an establishment of 100,000 employees. It is evident that the author prefers the one "chosen instrument" type of company to operate British world air transport and believes that a subsidy may be necessary to meet foreign competition.

The Empire Air Mail Scheme, which made it possible to send letters to any part of the British Empire for the equivalent of 3 cents and which increased the mail carried by Imperial Airways from 1.7 million ton-miles in 1936 to 9.6 million ton-miles in 1938, is described as unhealthy financially because the Post Office paid more than it received in postage.

It is predicted that "all the different national air lines of the world, including ourselves, will have to buy our equipment for some years to come" from the United States. Larger air terminals are needed, and a change in the attitude of the British government is urged. The pamphlet is challenging in its statements and gives a background for any discussion of postwar air transportation. W. H. Allen & Company, Ltd., London, 1943; 64 pages, 9*d*.

Plastics Catalog 1944

Chapters: Plastics in War; Tests and Specifications; Materials; Engineering and Molding; Fabricating, Finishing and Assembly; Machinery and Equipment; Laminates, Plywood and Vulcanized Fibre; Coatings; Synthetic Fibers; Synthetic Rubber and Rubber-Like Plastics.

The 1944 edition of this annual reference book brings up to date the history and achievements of plastics materials in industry. The shift in production from civilian to war goods is illustrated and described. The new edition contains more than 1,000 pages of informative material, intended to encompass the scope of plastics production and development. The numerous new articles included in the current edition give information about many new materials and new manufacturing methods.

The editors have selected 40 typical and important plastics developments used by the various branches of America's armed forces. Wherever possible, actual figures on time, man power, materials, weight, and money saved are given. Available data concerning presently restricted materials that have been developed and used since the attack on Pearl Harbor, and whose strategic importance precludes any detailed discussion, give an advanced view of the wide vista of postwar plastics. The many newly developed materials, proved in the test of war, are outlined. Each may become not only a new chapter in the first postwar *Plastics Catalog* but may open a new field of endeavor for plastics. The editors expect that such names as styraloy, polectron, penacolite, cycleweld, and reanite will be familiar terms in future years.

The expanded editorial contents cover such new materials as allyl resins, laminac, ion-exchange resins, plastics from agricultural products, Nylon, molding powder, and synthetic resins in the paper industry. New techniques of manufacture developed to meet wartime production requirements are covered in the chapters on molding with high-frequency power, casting thermoplastics, blowing of thermoplastics, low pressure molding of laminates, and fabricating polystyrene. Expanded outlines for plastics in the adhesives and coatings field are recognized through additional articles on coatings for paper, coatings for textiles, and a new chart of plastics used in liquid coatings.

The laminates section covers glass fabric laminates, high-strength paper-base laminates, post forming of B and C stage laminates and special plastic plywood developments. A special chart details in flow-sheet form the manufacture of raw plastic materials. Another indication of plastics growth and maturity is the innovation of the section on tests and specifications, which includes procedures on the identification of plastics, a list of standard testing methods, and the approved A.S.T.M. specifications for plastic materials. Many aircraft applications of plastics are described and illustrated.

Also included in this book is a directory and index section which gives plant and personnel information about plastics manufacturers; glossary of commonly used terms; up-to-date bibliography, including foreign-language publications; and a list of educational institutions sponsoring plastics courses. The twelve sections of the book contain nearly 150 articles. Plastics Catalogue Corporation, New York, 1943; 989 pages, $6.00.

Guide to Flying

S. E. Veale

Chapters: The Pilot and His Aeroplane; The Airframe; The Aero-motor; The Airscrew; Aerodynamics; At the Controls; Instruments; Air Navigation.

This introduction to the study of the airplane and its operation is intended for those with no previous knowledge of the subject. It is written with the object of helping the student during his initial training course. The whole field of flying is surveyed. The author explains the reasons why airplanes are built in particular ways and tells about the limitations of engines and propellers which must be accepted. His aim has been to combine description with explanation and to anticipate questions. The principles of flying and navigation are given in easily understood language. Temple Press Ltd., London, 1943, 192 pages, 10*s*. 6*d*.

Workbook in Pre-Flight Aeronautics

Col. Rollen H. Drake

A workbook written primarily as an aid to the student but also suitable for assisting the teacher in determining the material to be covered in the preflight aeronautics course. Instructional material is not included. It is intended that the student use the assignment sheet as a helpful guide in making his preparation for the class assignment.

The book follows closely the sequence of most textbooks in preflight aeronautics, but, since each of the work sheets is complete in itself, they may be used in any order by referring to the table of contents and selecting the sheet appropriate to the class assignment. When preflight aeronautics is taught as a science course, the science experiments at the end of the book are intended to be performed at the appropriate place in the course. The Macmillan Company, New York, 1943; 177 pages, $0.48.

The Airframe and Engine Fitter's Manual

P. H. Simpson and H. R. Langman

Contents: Principles and Construction; Hydraulic Equipment of Aircraft; Aircraft Braking Systems; Magnetos; Sparking Plugs; Electrical Equipment and Accessories; Basic Engineering and Elements of Mechanism; Engines; Carburetors; Variable-Pitch Propellers.

The authors have brought together, in a form convenient for ready reference, items of information which are required in the every-day work of those responsible for the servicing of aircraft. Although this is a British publication, some American air-frame and engine accessories are discussed. George Newnes, Ltd., London, 1943; 216 pages, 6*s*.

Practical Problems in Air Navigation

R. K. Vandervord and A. N. Ryles

Contents: Latitude and Longitude; Calculation of Tracks and Distances; Problems in Variation and Deviation; Correction of Courses and Bearings, etc.; Critical Point Deviation Card; Graph of Residual Deviations; Air Plot; Bearings; Air Speed Indicator; Problems of the Air Speed Indicator; Altimeter Problems; Worked Example of "Ground Flight" Plotting Exercises;

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Miscellaneous Exercises No. 1 and 2; Ground Flight Exercises.

A book written for the purpose of providing instructors and cadets of the Air Training Corps with a series of practical exercises, graded progressively and based on the recommended syllabus of training. Accompanying the principal sections of the text are "worked examples," which are provided not only for their instructional value but also to demonstrate the layout of the work. Where possible, the problems are solved both graphically and by trignometry. Gale & Polden, Ltd., London, 1943; 60 pages, 3*s*. 6*d*.

Aircraft Engines in the World 1944

Paul H. Wilkinson

Contents: Standardized Engine Data; United States of America—Air-cooled Franklin, Allison, Continental, Guiberson, Jacobs, Kinner, Lycoming, Menasco, Packard, Pratt & Whitney, Ranger, Warner, Wright; Auxiliary Engines: Andover, Eclipse, Lawrance, Onan; France—Gnome-Rhone, Hispano-Suiza, Renault, Salmson; Germany—Argus, B.M.W., Bramo, Daimler-Benz, Hirth, Junkers, Zündapp; Great Britain—Alvis, Armstrong Siddeley, Blackburn Cirrus, Bristol, de Havilland, Pobjoy, Napier, Rolls-Royce; Italy—Alfa Romeo, C.N.A., Fiat, Isotta Fraschini, Piaggio; Japan—Mitsubishi, Nakajima; U.S.S.R.—M-38, M-88, M-105; Engine Tabulations; Index of Engines; Engines omitted from 1944 edition.

The 1944 edition is the second volume of this reference book of international scope. It contains data descriptive of 130 of the latest aircraft engines including 10 of the new auxiliary engines used on aircraft, with 142 illustrations. The United States section contains 48 standardized pages of engine specifications, and there are 12 standardized pages for France, 20 for Germany, 28 for Great Britain, 17 for Italy, 2 for Japan, and 3 for Russia. Condensed data are given for 275 variations of these basic power plants. All of the material has been revised. There are 65 new pages of engine details, and 15 pages of obsolete matter have been omitted. The information is given in both English and metric systems of measurement.

Among the latest engines illustrated and described in detail are the air-cooled Franklin 4ACG-199 and 6ACG-298; the Allison V-1710-E19, V-1710-F17, and V-3420; the Continental C-75; the Lycoming GO-435; the Packard V-1650-1; the Pratt & Whitney Double Wasp R-2800; the Wright Cyclone 18; the Gnome-Rhone 14R and 18R; the Hispano-Suiza 12Z; the B.M.W. 801; the Daimler-Benz DB 601-E; the Armstrong Siddeley Cheetah XV; the Bristol Mercury 30; the de Havilland Gipsy Six IIIS; the Rolls-Royce Merlin XX, 45, and 61 and the Vulture; the Japanese Mitsubishi Kinsei and Nakajima Sakae; the U.S.S.R. M-38, M-88, and M-105; and auxiliary engines of Andover, Eclipse, Lawrance, and Onan manufacture.

Brief descriptions also are included of the two-stage Packard V-1650-3; the Pratt & Whitney Twin Wasp R-2000 and two-stage Double-Wasp R-2800-10; the B.M.W. 802; the Daimler-Benz DB 603, DB 605, and DB 606; the Junkers Jumo 222 and Jumo 223, the Bristol Centaurus; the Napier Sabre; and additional Japanese and U.S.S.R. engines.

Several new features have been introduced in this edition. The introduction now gives the products of the various aircraft-engine manufacturers in each country and the types of aircraft in which their engines are used. The standardized data pages now include lubrication pressures and the grades of lubricants recommended. Tabulations have also been included giving the general characteristics of the engines built in each country. Paul H. Wilkinson, New York, 1944; 320 pages, $8.50.

Book Notes

Why Sea Power Will Win the War, by Rear Admiral Yates Stirling, Jr.; Frederick Fell Inc., New York, 1944; 319 pages, $3.00.

Admiral Stirling's book title makes the bold claim that sea power will be the principal force to bring victory. At the end of the first chapter he writes: "Naval power under present world conditions may not be able by itself to win the war, but the war cannot be won without the help of that element of seapower—warships. In cooperation with submarines and airplanes, surface warships adequately cover the fighting in all three elements on the seas; the surface, the sub-surface, and air. Who then can say to which the most credit will be due?"

The book is largely a compilation of articles written by the Admiral for newspapers, with chapters in which he attempts to refute the claims of "air-minded critics of the Navy."

Probably no naval officer has given air power such praise, even though he seems to regard it only a tactical adjunct to the Navy. He gives arguments against a united air force which do not consider the strategic potentialities of air power. The book reflects the present attitude of the Navy toward air power and shows the great change of opinion of older naval officers since the beginning of this war. It will be read with the greatest interest by airmen who sometimes underrate the need of a strong navy.

The Bombed Buildings of Britain, edited by J. M. Richards; The Architectural Press, Cheam, Surry, England, 1943; 140 pages, 15*s*.

Until one sees the wanton destruction or irreplaceable historic and religious buildings such as are pictured in this book he is apt to regard bombing as only a part of military or naval warfare. Here is depicted the heritage of English architectural genius—some of the buildings having great beauty, others not so worthy, but all almost completely ruined. The author comments frankly about each building, evaluating its worth from an architectural standpoint. An examination of the hundreds of pictures that show the damage to many important buildings will create a sympathy with the English for their great losses.

Flying with the Coastal Patrol, by Lewis E. Theiss; W. A. Wilde Company, Boston, 1943; 315 pages, $2.00.

A picture of the Civil Air Patrol in operation is given in this story of the activities and adventures of two young men assigned to Coastal Patrol Work.

It tells how the young men, having completed their secondary civilian pilot-training course and while awaiting the call to active duty with the armed forces, undertook to prepare a guide-book for airmen who fly over the mountainous regions of Pennsylvania. They constructed a chart on an original plan and rendered various other services. After they joined a C.A.P. unit for submarine patrol work, they had numerous adventures, culminating in a part in the sinking of an enemy submarine.

Annual Report of the Board of Regents of the Smithsonian Institution; U.S. Government Printing Office, Washington, D.C., 1943; 421 pages, $1.50.

The 1942 annual report gives a detailed account of the operations and expenditures of the Smithsonian Institution. From an aeronautical point of view, the report is of great importance because it publishes the statement of Dr. C. A. Abbot, Secretary, in which he corrects may of the misstatements that have been made in previous reports about the Langley aerodrome. The acceptance by Orville Wright of this report made it possible for him to announce that he would return the Kitty Hawk plane to this country. Mr. Wright is quoted as writing· "I hope that the relations between the Institution and myself may again be as amicable as they were in Dr. Langley's administration."

Insignia and Decorations of the United States Armed Forces, by Gilbert Grosvenor; National Geographic Society, Washington, D.C., 1943; $0.50.

This most useful pamphlet gives what is probably as complete a description of insignia and decorations as has been published. It has 1,701 color reproductions and many more in black and white.

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By Wilbur C. Nelson

Professor of Aeronautical Engineering and Head of the Department, Iowa State College

Practicing engineers in the airframe, engine, and propeller industries will find in this book a brief but thorough treatment of fundamental principles underlying design and operation of the modern airplane propeller. The material includes aerodynamic analyses, structural analyses, properties of materials, and performance tests. It throws much light on the difficult problems of design and construction involving thrust, torque, and stress. The book is literally packed with valuable information, which will serve as a strong background for specialization.

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With the great number of additions to such insignia during this war and the thousands of officers and enlisted personnel entitled to wear them, such a reference identification guide will be of the greatest interest to the public, as well as those in service.

As the Archives of the Institute has a large collection of aviation insignia, the listings have been particularly helpful in checking for completeness.

Wings Over Europe, by Capt. Jon Waite; Cupples & Leon Company, New York, 1943; 208 pages, $0.60.

A novel about an Oklahoma boy who joined the Army Air Forces and became a bomber pilot. His experiences in locating from the air escaped Germans on the Mexican border were preludes to his trip on a convoy to England. Flying a Mitchell bomber, he made many sorties over the Continent.

On a photographic mission he had a fight with Focke-Wulfs and another with Messerschmitts. His experiences after a forced landing in France and eventual escape to England in a Commando boat make the story have all the elements of adventure any pilot could desire.

The Pocket Planisphere, by Francis Chichester; George Allen & Unwin, Ltd., London, 1943; 2*s.* 6*d.*

A well-known English air navigation specialist has designed a simple guide to the stars that appear at any time of the night or year over north Europe, central North America, and southern Australia. Using two rotatable discs, which may be set quickly, the navigator may instantly find the location of the important navigational stars. Bound stoutly for hard usage, the planisphere will be a useful aid to any air navigator.

Teach Yourself to Fly, by Wing Comdr. Nigel Tangye; The English Universities Press, Ltd., London, 1943; 157 pages, 3*s.*

The fact that an eighth edition of this simple preflight instruction book has been necessary since 1938 is a clue to its excellence. It is written for the student pilot and acquaints him with what he will encounter after he gets into the air with an instructor.

By having an acquaintance with the rudiments of flight and aviation terminology, the instructor will be saved much time and the pupil can more easily comprehend the teaching. The book will also interest those who travel by air, since they will be able to understand better the technique of the operation of any airplane.

The Airman's Guide to His Rights and Duties, by John L. Williams; Frederick Muller, Ltd., London, 1943; 80 pages, 1*s.*

This legalistic pamphlet gives information to the English airmen about pay and allowances, clothing and equipment, trials, their relations to the civil law, discharge, pension, and the routine of court-martial.

Although many of the regulations are similar to those of other services, there are variations that will be important for any airman to know.

To the civilian with no previous military experience, such a clear statement of rights and duties and their limitations will prove to be of inestimable value by indicating what must be avoided to keep clear of offenses against the Royal Air Force as well as the Common Law.

China Handbook 1937–1943, compiled by the Chinese Ministry of Information; The Macmillan Company, New York, 1943; 966 pages, $6.00.

This reference book will be useful to the many Americans who will visit China, since it gives a comprehensive survey of the major developments in China in six years of war and a "who's who" of the prominent men and women in China. In addition to a broad historical survey and description of the governmental structure and organization, it gives much useful information regarding natural resources and industry.

The organization and activities of the Chinese Air Force are described and the various aeronautical educational advantages are listed. The scope of the educational facilities will be suprising to many and gives the promise of great future aeronautical development by the Chinese.

Air Transport, edited by Ronald Walker; P. S. King and Staples Ltd., London, 1943; 56 pages, 2*s.* 6*d.*

In the present confused state of opinion on postwar air transport any views, even though they have to be published in the format of a magazine, are welcome. This pamphlet gives a review of the problem as seen through British eyes. It is severely critical of the lack of interest and support hitherto given to Empire air transport. It does show, however, that there has been an awakening in England to the importance of making plans now for the international competition that is certain to come after the war. Officials and civilian committees are studying the problem. Designers and engineers are making plans for large commercial aircraft. The more such informing disclosures are available, the easier it will be to reach mutual agreements.

Biggles in the South Seas, by Capt. W. E. Johns; Oxford University Press, New York, 1943; 255 pages.

A novel written around the adventures of an English pilot and his comrades in the South Seas. They used a flying boat in a search for pearls. Their experiences with the natives, the difficulties of the operation of aircraft among primitive surroundings, and their final escape make a story abounding in thrills and interest.

Dispersal Point and Other Air Poems, by John Pudney; John Lane the Bodley Head, Ltd., London, 1943; 31 pages, 2*s.* 6*d.*

The Times Literary Supplement reviewer writes that "the war has not been sung hitherto with such fineness and force." It is true that the war has

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not, as yet, brought forth a poet of great fame. Therefore a book of poetry about the pilots of the R.A.F. is a welcome relief from the deluge of prose that almost surfeits those who try even to scan the output of publishers. Written "never far from the sound of aircraft engines," the short poems have a quality of nearness to the gay life and the sad tragedies of airfield and combat. Covering the whole range of emotions from the carefree moments of leisure and relaxation to the end points of a pilot's career, the poems may be, as the publishers believe, "the first important collection of poems of this war."

He's in the Sub-Busters Now, by A. D. Rathbone, IV; Robert M. McBride & Company, New York, 1943; 234 pages, $2.00.

The way in which the enemy submarine menace is being overcome is the theme of this book. It describes the many kinds of attacking surface and aerial craft and their operating methods. The blimp and the flying boat are credited with successful action against submarines. It is suggested that the helicopter may be used eventually for this purpose.

Elmore, by Theodore J. Ritter and Robert W. Gadbois; The Dietz Press, Inc., Richmond, Va., 1943; $1.00.

A series of cartoons depicts Elmore's progress through a naval cadet training course. This book is the first of a series of five and takes the cadet through the Flight Preparatory School. The authors, now actively in training, plan the script and cartoons from their own actual experience. It gives an amusing impression of a pupil's life in training.

The Sea Eagle, by James Aldridge; Little, Brown and Company, Boston, 1944; 310 pages, $2.50.

The story of Angus Burke, who was caught on Crete during its capture by the Germans. With a Greek and an Australian, he had a thrilling experience with the natives. It is a novel of Cretan life and the people's fight against the invaders.

Britain and World Air Transport, by B. J. Hurren; John Crowther, Ltd., London, 1943; 56 pages, 2*s.* 6*d.*

This pamphlet, after giving an account of the backwardness of British air transport, makes a farsighted suggestion. It is pointed out that great cities have grown because of their location as shipping and rail centers. Instead of superimposing airport facilities at points that have other existing terminal advantages, the writer proposes that, since the size of airports may have to be greater than at present projected, towns be built which are primarily aircraft terminals. These could be designed around an airport that need not be restricted by present high land values and numerous buildings. They need not necessarily be in countries that are now densely populated but should be on continents where new population is needed and which are on international air routes of the future.

Civil Aviation, by Harold D. Phillips; A. Phillips, Newport Mon, England, 1943; 198 pages, 5*s.*

A commentary on civil aviation in the British Empire, written by the editor of the *Air Mail Magazine.* The book is essentially a review of "airgraph" types, which in this country we call V-mail, and a brief classification of the first air-mail covers of many countries. Interspersed in this air-mail lore are accounts of famous flights and biographies of several famous pilots. The book will be of special interest to philatelists.

Lend-Lease, by Edward R. Stettinius, Jr.; The Macmillan Company, New York, 1944; 358 pages, $3.00.

The part that aircraft production had in the Lend-Lease program was so important that it is natural that its administrator should give it extended attention in his book. It will interest those in the industry to read the inside story of how the English and French governments made their early contracts for airplanes and aircraft engines and how suddenly the British took over the entire commitment of the French.

After the Lend-Lease Act became law in 1941, the sending of arms and supplies to our allies increased enormously. A chapter is given to the remarkable development of the air lanes to all parts of the world. It is too early to give full details of the delivery of aircraft and equipment to Europe and Asia, but Mr. Stettinius lets enough be known to indicate the great service rendered by our producers of aircraft.

Civil Defence: A Basic Training Manual, by Lt. Comdr. F. A. M. Eden; Jordan & Sons, Limited, London, 1943; 87 pages, 2*s.*

This pamphlet was written for members of the British Red Cross to give an elementary background for the treatment of the injuries caused by gas, bomb, and incendiary attacks. It describes the most effective use of respiration devices and gives the essential information to acquaint a civilian with the best procedure to follow after air raids.

The Physical Examination of Metals, by Bruce Chalmers and A. G. Quarrell; Edward Arnold & Company, London, 1943; 280 pages, 16*s.* 3*d.*

In covering the subject of the application of physical methods to the examination of metals, the authors have given, in a single volume, an account of those techniques that may be broadly classified as electrical in contrast to the "metallurgical" methods. They have attempted to indicate the scope and limitations of each of the methods.

This Volume II of a series is intended to be useful to those concerned with the development of new or more specialized tests for metals and metallic components. It is also offered for the use of that greater number who, through lack of readily available information, are forced either to accept without discrimination the results of tests they do not fully understand or to forego the advantages of the most modern methods.

English for Airmen, by A. R. Moon; Sir Isaac Pitman & Sons, Ltd., London, 1943; 110 pages, 3*s.*

This course in English for air personnel is aimed at giving cadets in the R.A.F. a ready and accurate command of English so that information and instructions may be immediately understood.

With this special purpose in mind, the writer stresses the difference between note-making and précis writing, the virtues of conciseness and accuracy when sending messages or making reports, the importance of an orderly arrangement and presentation of facts, and the relation of sketch maps to written matter.

The book should prove to be a useful and interesting guide for airmen.

Practical Sheet and Plate Metal Work, by E. Arthur Atkins; Sir Isaac Pitman & Sons, Ltd., London, 1943; 606 pages, 10*s.* 6*d.*

The fifth and revised edition of a book written for those who require a knowledge of the working of metals or the development of surfaces. A feature of the book is that the patterns are shown set out as they would be in the workshop, with hints as to the allowances for joints, wiring and notches and bending up, and the use of tools.

This new edition contains additional information about the composition and properties of metals used by the plate and sheet-metal worker. It was not considered necessary to alter the first 34 chapters, but revision was needed to bring Chapters XXXV to XLVI up to present-day standards. This includes many additions and corrections to the treatment of sheet-metal joints in Chapter XXXV and considerable alterations to the tables in Chapter XXXVIII on metals and their properties. Chapter XL on annealing and welding has been revised, while alterations were required and new matter has been added to the treatment of corrosion of metals, metal testing, and particulars of metals and alloys. Generally, revision has taken the form of changes to the information given about the properties of metals and alloys, together with new data regarding their performance, treatment, and testing.

Roget's Dictionary of Electrical Terms, by S. R. Roget; Sir Isaac Pitman & Sons, Ltd., London, 1943; 432 pages, $4.50.

Words used in the field of electrical communication are included in this fourth edition of a dictionary covering the expressions in common use in the science and applications of electricity and magnetism.

The range covered embraces electric light, power, and traction; electrical communication, including radio, and other miscellaneous applications in some detail; and the general science of electricity and magnetism, without proceeding too far into its ramifications in pure physics and chemistry, etc., in one direction or into the commercial side of industries dependent upon electrical methods in the other.

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Aerodynamics, by N. A. V. Piercy; The English Universities Press, Ltd., London, 1943; 423 pages, 30s.

This survey of the fundamentals and methods of aerodynamics covers the revised syllabus of London University. It presents the modern science of aerodynamics and its immediate application to aircraft. The first five chapters and the simpler parts of the next seven chapters constitute an undergraduate course. More advanced matter is included to serve especially the designer and research engineer. No attempt has been made to summarize reports from the various aerodynamic laboratories, to which the reader is referred for design data.

Examples are worked out to show applications of the theorems and semi-empirical laws to the field of practical aeronautics. The volume is intended to provide a reference source on principles for the aircraft designer and technician, and it is anticipated that the breadth of treatment adopted will furnish research students with an introduction to the bibliography of the subject, both mathematical and experimental.

The Girl Mechanic's Manual, by Daniel J. Brimm, Jr.; Pitman Publishing Corporation, New York, 1944; 166 pages, $1.75.

Written especially for women who are learning to take part in the mechanical work of building planes, tanks, guns, and ships for the war, this book gives basic information for mechanics presented in a form that should be readily understood. An informal style of presentation, which may be slightly unorthodox, has been used to overcome the possibility of dullness. The book describes the clothes that should be worn in the shop, gives some elementary instruction in shop arithmetic, explains the use of many types of tools, and provides the reader with an understanding of mechanical drawing.

Air Age Gas Models; Air Age Inc., New York, 1943; 144 pages, $2.00.

This guide for model airplane builders contains instructions for the construction of 21 gas models of different classes and types. Instructive articles, charts, and diagrams are also given to aid the gas-model builder.

Aircraft Spotter, by Lester Ott; Harcourt, Brace and Company, New York, 1943; 64 pages, $1.00.

The Autumn 1943 edition contains introductory instructions covering the fundamental steps in aircraft identification, based on the shape of the wings; their position with relation to the fuselage; the form of empennage; and the number, type, and placing of the engines. It then gives, in standardized form, photographs, three-view drawings, and text matter on the military airplanes of the United States, Great Britain, Germany, Italy, Japan, and Russia. There is an alphabetical list of airplanes, including the type designations, and several quiz pages showing photographs in various positions from which the reader may test himself.

(*Continued on page 179*)

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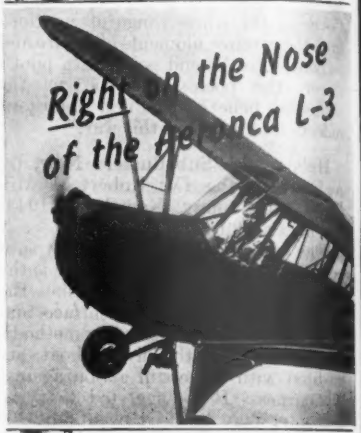

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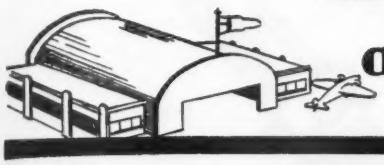

Aircraft Bearings

Anti-Friction Bearings for Military Airplanes. Joseph P. Vidosic. In the second of a series of three articles, the Director of the Accessories Unit of the A.A.F. Matériel Command's Aircraft Laboratory discusses the testing of antifriction bearings of the ball, needle, and roller types used in such mechanisms as pulleys, bell cranks, and universal joints. These are tested primarily as bearings, in contrast to the practice followed with regard to bearings used in assemblies such as propellers, instruments, crankshafts, or armament, which are tested as part of the assembly. Three steps involved in the complete qualification procedure are given as: (1) laboratory tests, (2) fabrication control, and (3) service experience.

For the purposes of the present article, the second and third steps are merely defined in general terms to an extent sufficient to permit evaluation of their overall importance. The laboratory tests are treated at length since they constitute the measure by means of which the bearings are qualified. The procurement specifications that govern general qualifying requirements and specific strength tests to assure suitable properties for military aircraft are outlined as tentative or final, and the six principal laboratory tests are listed. Tests for precision of manufacture through measurements of balls and races for radial and axial play and eccentricity are described, as well as Brinnell and non-Brinnell determinations. Details are given on the apparatus and methods used in these tests and in the measurement of friction and endurance. Although the tests described are not characterized in every instance by the exactness and thoroughness of academic research, their function is stated to be one of control and development to assure a steady supply of bearings satisfactory for military aircraft and to improve the test methods.

The third article in the series deals with the use of substitute bearings for applications where antifriction bearings are indicated but are not available. Differences between the characteristics of the antifriction type and the sliding-friction type are explained on the basis of frictional torque, variation of temperature, corrosion, endurance, and other factors. Five criteria are suggested as determining the acceptability of a substitute bearing, and procurement specifications containing requirements similar to those established for antifriction types are listed. Distinctions between the specifications for the two types are outlined. Information is given regarding the lubrication of so-called substitute bearings. Although the limited experience in the use of such bearings does not permit a thorough evaluation at present, it is believed that if overenthusiasm and ultraconservation are avoided the application of substitute bearings can be made to offset any possible shortage of antifriction types for military aircraft. *The Bearing Engineer*, October, 1943, and November-December, 1943.

Instruction Sheets for Pioneer Instruments

Several additions have been made to the instruction sheets for Pioneer aircraft instruments. These include Nos. 311-29A (superseding 37-24C); 39-15C (superseding 16-9B); 39-20D (superseding 17-22A); and 38-21 (restricted); as well as new bulletins 36-22C, 39-29A, and 38-19.

No. 311-29A is a service bulletin on the modification of turn-and-bank indicators for Link Trainer, using conversion kit DM-2. It covers types 1705-A1, A2, B2, and 1723-A2. No. 36-22C gives overhaul information for rate-of-climb indicator type 1636-A1. No. 39-29A is a service bulletin dealing with the effect of change in specific gravity of gasoline on indicated rate of flow for autosyn fuel-flow meter transmitter type 9054-A.

Installation and line-maintenance information is contained in bulletins 38-19, 39-15C, and 39-20D. The first covers oil-quantity switch, types 10050 and 10054; the second, electrically heated pitot-static tubes, types 1079-940, 3202, and 3219; and the third, rate-of-climb indicators, types 1634 and 1636. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Precision Inspection

The Eyes of Industry. The functions and equipment of the gauge-testing laboratory of Bell Aircraft's Ordnance Division are reviewed. Among the quality-measuring devices noted are the Sheffield Visual, Jo blocks, Chute gauge, and Pratt & Whitney Electrolimit. Cognizance is also taken of the important contribution made to the efficiency of the department by a gauging policy that covers the intelligent selection and specification of gauges in accordance with gauging theory and which includes a standard method of evaluating and allocating both gauge-makers' tolerances and wear allowances. *The Bellringer*, January, 1944.

Manual on Thread-Milling Cutter Sharpening

A pocket-size technical manual has been compiled as an aid to faster, more accurate sharpening of thread-milling cutters, gear hobs, etc. This bulletin, HT-43, includes tables of equivalent offset distances for all angles of rake from 1° to 25°, in 1° steps, and for all sizes of cutters between $^3/_8$-in. and 7-in. outside diameter, in $^1/_{16}$-in. steps. Offset distances from special angles and other diameter cutters can be computed from a given formula.

The booklet contains suggestions for setup, grinding, hook, lead, and flute-spacing checking, as well as for the prevention of runout and other errors in the sharpening of thread-milling cutters. A section of factors affecting thread-form accuracy offers guidance in the correction of thread-form and pitch-diameter errors. *Detroit Tap & Tool Company*, Detroit.

Mechanized Processing

The Heat's On! John Babcock. The mechanized "heat-treat" systems used by the metal-processing departments of North American's Texas plant are described. Details are given on the operation and action of the automatic conveyer-type combination furnace and quencher that forms the basis of the new techniques. *North American Skyline*, November-December, 1943.

Production Improvement Bulletins

Production Improvement Bulletin No. 78 describes and illustrates a roller-type form die designed to form straight flanges in ST materials, allowing for calculated spring back, and gives the action of the tool. *Bulletin No. 79* describes a bomb-door safety lock. *Bulletin No. 80* shows the use of a leverage handle for a screw driver to loosen tight screws without the aid of pliers, wrenches, or other tools. *Bulletin No. 81* contains data on pliers for removing tightly fitting parts from form blocks. *Bulletin No. 82* is about a wall-chart that may be used for recording reference information pertinent to a job.

Production Improvement Bulletin No. 83 covers the piercing hole pilot light. It illustrates a pilot-finding light designed to lessen the difficulty in aligning stock over the pilot. The light can be installed on any machine where definite location of the part is required for such operations as perforating, riveting, forming, etc. *Bulletin No. 84*

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illustrates the Iris plug vise designed to facilitate the holding of parts difficult to grip in a conventional vise. *Curtiss-Wright Corporation, Airplane Division.*

Air Line Maintenance Records

Airplane Log Records. Tom Cannon. Indicating its correlation with the Routing Office, the functions of the Airplane Record section of American Airlines' Maintenance Department are outlined. The Airplane Record Office is reported to be responsible for maintaining the license data on all airplanes, seeing that they conform with C.A.A. regulations. It is also charged with keeping an accurate record of each airplane's total time and time since the last major overhaul, engine change, propeller change, and major inspection. It maintains the master logbook for each airplane, as well as the engine and propeller time board. The purpose of each of these records is explained. *Flagship News,* February, 1944.

Data Book for Ball Bearings

The 1944 Edition of *Interchangeable Ball Bearings for Replacement* is available. The book contains numerically arranged lists of ten competitive makes of ball bearings together with corresponding numbers put out by the New Departure Division of General Motors Corporation. In addition, it includes four other sections: a table of the company's bearing dimensional tolerances, according to various A.B.E.C. specifications; a section explaining the meaning of prefixes and suffixes used with each make of bearing; comparative bearing type and series numbering systems; and an interpretation of New Departure bearing numbers for applying numerical designations to various bearing characteristics. *New Departure Division, General Motors Corporation,* Bristol, Conn.

Services of a Subcontractor

Necessity—Ingenuity. The story of how a former firm of automobile dealers became subcontractors for the Bell Aircraft Company. Although their machine shop was not established until 1942, the Whitman-Jesson Company is reported to have an acceptance record of 99.4 per cent on their job of manufacturing stabilizer supports, main gear housings, fixed armament knobs, and center fittings for Bell Aircraft Corporation. *The Bellringer,* January, 1944.

Forging Metals

A reference data book titled *The Improvement of Metals by Forging* has been published. Employing charts, photographs, and detail drawings, this pamphlet presents 36 pages of technical data on types of forgings, forging-design principles, forging processes, and the metallurgy of forging. There is also a section devoted entirely to metal specifications and physical properties of various widely used steels. *The Steel Improvement and Forge Company,* Cleveland.

Designing for Production

Engineering Production. An outline of how aircraft models developed by the design engineers are redesigned for volume manufacture by production engineers. It is noted that production engineers bridge the gap between the aerodynamic knowledge of the airplane development engineers and the manufacturing knowledge of tooling engineers, industrial engineers, and skilled supervisory personnel. The breaking down of the plane into relatively small assemblies for volume production is described. *Plane Talk,* January, 1944.

Metallurgy Department

Metal Marvels. The activities of Boeing's metallurgists are described. Illustrating the scientific research work of the metallurgic laboratory by an account of experiments with a bulkhead ring, the article goes on to note how the metallurgy department is also engaged in the checking of metals for the inspection department and in the examination of spot welds, flash welds, and swaged terminals. Some early metal experiments in which Boeing was concerned are mentioned. *Boeing News,* January, 1944.

The How and Why of Plastics

Facts About Plastics. A 24-page, nontechnical booklet about various types of plastics and their applications has been released. It indicates the properties that fit plastics to a wide range of present and postwar uses, explains the limitations of plastics, and imparts some general information about the plastics industry.

The two main groupings of plastics—thermosetting and thermoplastic—are described and illustrated. This is followed by sections telling about the laminated and molded forms of plastics and by data relative to the manufacturing and production processes. *The Richardson Company,* Melrose Park, Ill.

Producing Precision Instruments

Boosting Volume Output of "Elmers." A series of notes regarding the methods by which the Aviation Products Division of the Electric Auto-Lite Company manufactures automatic pilots and directional gyro indicators. Facilities, training of personnel, testing of precision equipment, and the limited use of conveyer-line techniques are among the subjects discussed. *Steel Horizons,* Vol. 6, No. 1.

Local Landing Facilities for the Postwar Era

What Your Town Needs for the Coming Air Age. William T. Piper. Advice on the type of airplane landing facilities that will be required for American communities after the war is presented in a 36-page pamphlet published by the President of Piper Aircraft Corporation. Stressing the reasons why local landing facilities are necessary for the future industrial and economic development of a town, the booklet discusses three categories of peacetime flying—long-distance air transportation, short-haul air transportation, and private flying—and forecasts some general specifications of postwar aircraft.

It then goes on to describe different types of landing facilities suitable for the accommodation of future air traffic. These include straight, L-shaped, and T-shaped landing strips; an airport on the edge of town; a combination land-water airport; an airport in a park or fair grounds; and a river seaplane base. In conclusion, suggestions are given with regard to the following factors in building landing fields: land, approaches, cost, engineers, hangars, concessions, cars for rent, flying service, financing the project, and the importance of uniform regulations. *Piper Aircraft Corporation.*

Transparent P-39 Mock-Up

P-39 Under Glass. Details are given on the transparent electrical mock-up of a full-scale Airacobra which is used as a training device at Camp Bell. By stripping the plane structure of its outer coverings and replacing these areas with Plexiglas, the Bell Aircraft school enables students to observe the exposed electrical system of the P-39 with every circuit in an operative condition. A specially constructed switch panel lights up small electric bulbs to illuminate the phases of instruction. *The Bellringer,* February, 1944.

Copper and Copper Alloys

Revere Copper and Copper Alloys. Technical information about 45 principal Revere alloys is contained in a 34-page booklet. The material includes graphic charts showing the complete ranges of the alloys' physical properties, A.S.T.M. specifications, and data on the general and working properties of the alloys as well as on their typical uses and applications. In addition, the booklet describes the manufactured forms available. There are also special sections covering the techniques for welding nonferrous alloys and for the bronze welding of ferrous metals. *Revere Copper and Brass Incorporated,* New York.

Instrument Tests

Instruments on the Beam. Methods, equipment, and simulated conditions for testing flight instruments in the laboratories of North American Aviation, Inc., are noted. Data are included about laboratory tests for directional gyros, bank-and-turn indicators, temperature indicators, altimeters, and magnetic compasses. *North American Skyline,* November-December, 1943.

Replacement Sheets for Overhaul Manual and Service Bulletins

Replacements have been issued for existing pages in *Jacobs Overhaul Manual* to conform with current conditions and standards. These revisions include changes in disassembly, inspection, repair, and assembly procedures. They

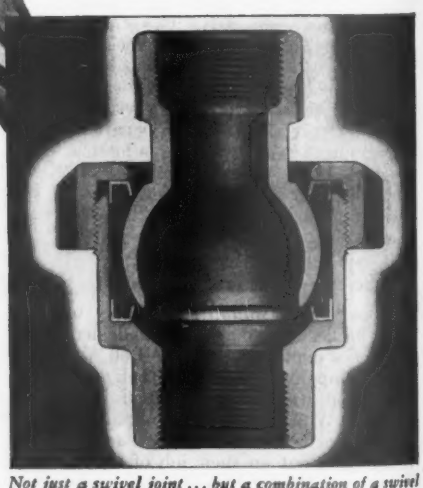
WHERE FLEXIBILITY IS A MATTER OF LIFE OR DEATH!

Up here oxygen is rare. You take your own along...to breathe. It's piped from a tank to you. The oxygen pipe must turn with the turret and the Barco Joint which does this, must also be flexible. Vibration, movement, shocks, contraction, expansion must be compensated for.

The fluid which hydraulically operates the gun turrets likewise must pass through flexible joints. You'd be in a bad spot with a Nazi fighter on your tail, if you couldn't move your gun turrets.

Barco Flexible Joints are used to keep our flyers breathing and firing. They are the movable fluid connection for landing gears and brakes.

Yes, men and machines must keep flexible in the joints to keep flying and fighting.



Not just a swivel joint ... but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

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BARCO *FLEXIBLE JOINTS*

"MOVE IN EVERY DIRECTION"

also cover changes in sources of supply for materials essential to the proper overhaul of Jacobs engines and provide other data such as revisions to the Table of Limits and an up-to-date tool list.

Additional sheets are also available for the company's Service Bulletins. *Bulletin No. 21* covers replacement and installation of cork seals and oil seals for accessory drive gears, and *Bulletin No. 26* covers propeller oil-supply tube assembly. *Jacobs Aircraft Engine Company*, Pottstown, Pa.

Production Control System

". . . At the Right Time." The production control system of Bell Aircraft's Ordnance Division is outlined. With the purpose of keeping inventories at a minimum and production schedules at a maximum, the system is based on the use of a group of charts and job cards. The master, or "anticipated production," chart lists every part that goes into every gun mount built by the company and indicates how many units will be in work every day and how many will be completed. It covers a period of a year and a month and enables a complete picture of the plant's production to be obtained at any given time. *The Bellringer*, February, 1944.

Flexible Shafting Data

The How and Why of Flexible Shafting. A 30-page catalogue, *Stow Book No. 441*, surveys the applications of flexible shafting in improved machine design for remote control and for power transmission of fractional or integral horsepower. Among the specific aircraft applications shown are flexible shafts for aircraft controls and flexible shafting as an element in the Link Trainer. *Stow Manufacturing Company*, Binghamton, N.Y.

Installing Outboard Gas Tanks

Tank Battle. Helen Call. A method for folding up outboard gas tanks so that they can be installed inside airplane wings is given. Warm air is applied to the tank by means of a hot-air hose. With the rubber of the container made pliable by this treatment, the tank is exhausted by a vacuum line, then compressed and strapped down, and finally inserted into the wing. When it is inside the wing, the straps are unbuckled and the bag expands to size. *Boeing News*, January, 1944.

Douglas Fir Plywood

Form Factors of I and Box Beams with Plywood Webs. Section VII is now available for the loose-leaf *Engineer's Handbook* issued by the Douglas Fir Plywood Association. Based on data published by the U.S. Forest Products Laboratory, this chapter covers form factors of I and box beams with plywood webs. Its discussion is divided into subheadings consisting of the introduction, the reason for form factor, formulas, the depth factor, and a numerical example. A graphic solution is shown of the U.S. Forest Products Laboratory formula for form factor at proportional limit of wood I and box beams. *Douglas Fir Plywood Association.*

National Aircraft Standards

New and revised standards sheets have been issued in blueprint form, covering a list of aircraft parts and supplies as follows: countersunk rivets, manifold port deicers, connector panel post screws, washers, and internal wrenching bolts.

NAS No. 180 comprises six sheets giving detailed specifications on aluminum-alloy, equal-leg, rolled-form angles. A chart accompanying these standards gives a list of the manufacturers equipped to produce these new standard parts. *National Aircraft Standards Committee.*

Fairchild History

Yesterday's "Touch of Tomorrow"—IV. Richard H. Depew, Jr. This fourth part of a continued article on the history of the Fairchild Engine and Airplane Corporation is concerned with the development of airplane sales for the FC-2. Beginning with the company's original airplane order, it includes who bought the plane and for what purposes it was used. Fairchild's first order from the Navy is noted and the application of the plane for Canadian bush flying is featured. Proceeding to modifications that were made on the FC-2, this installment also covers the development of the FC-2W and FC-2W2 and reviews some historic flights that were made in the two latter planes. *The Pegasus*, February, 1944.

Aircraft Applications for Adhesives and Tape

Two manuals for the aviation industry have been published by the Minnesota Mining & Manufacturing Company. Relating to *"3-M" Adhesives* and *"Scotch" Brand Tapes*, the two handbooks demonstrate application of these products in aircraft production.

The first book lists over 100 formulas of "3-M" adhesives for sealing, adhering, insulating, reinforcing, and sound deadening. Contents include complete physical data, comparative properties, and general operations in which the different adhesives are used.

The "Scotch" tape book contains illustrations of how this material is used to speed and improve production. Actual samples of the many varieties of tape are shown, with illustrations of the different uses and characteristics. Included are tapes for masking, electrical work, packaging, and identification. *Minnesota Mining & Manufacturing Company*, St. Paul.

Equipment for Recording Flight Performance

Flight Test Team. A series of notes on the flight instrumentation equipment used for testing the P-39. Included in the details is a description of the Electronic Intervalometer—a device developed by Bell engineers for controlling and actuating all the component parts of the instrument installation at the required time intervals. *The Bellringer*, January, 1944.

Hot Press Technique

Bulletin No. 13, from the British firm of Aero Research Ltd., consists of notes on hot-press technique. The notes are based on information supplied by The Resinous Products & Chemical Company of Philadelphia. After discussing veneer requirements and the use of cauls, the leaflet describes supplementary equipment—such as service tables, lifting bars, and pusher bars—and methods of charging the hot press. This is followed by advice on press operation, steam requirements, setting time, and stacking after pressing. *Aero Research Technical Notes*, January, 1944.

Navy Cost Inspection at an Aircraft Plant

The Navy Figures Costs. Reviewing the purpose and operating methods of the Navy Cost Inspection department at the Ryan Aeronautical Company, this article indicates how aircraft manufacturers' costs are audited by the Services under cost-plus-fixed-fees contracts. The routine is outlined by which purchase orders, bills, charge vouchers, tabulations of labor distribution, material requisitions, depreciation accounts, etc., are checked by the Navy Cost Inspection office. Comments are also included on the Naval and civilian personnel of the department. *Ryan Flying Reporter*, January, 1944.

Bombing Japan

Our Far East Strategy. Admiral William V. Pratt (Ret.). The problem of the air bombardment of Japan is discussed. Three routes for a bombing approach to Tokio—from Hawaii; from India through Burma and China; and from Australia through the Philippines, and on to China—are examined. The writer then explains the advantages of the last-named route, which he considers the most suitable. Consideration is also given to the types of long-range bombers best suited to the task. *Plane Talk*, January, 1944.

The Corsair and Its Predecessors

Wings for the Navy. The history of Chance Vought's naval plane production is given. Tracing the development that led up to the Corsair, this book tells the story of the company's background, its plant expansion, and its construction of other types of aircraft for the U.S. Navy. It also describes the performance record of the present Corsair and some of its predecessors. *Chance Vought Aircraft Division, United Aircraft Corporation.*

Rubber Substitutes for Engine Parts

Woman Scientist Tests Ranger Parts. A survey of the various tests that were

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accorded to synthetics in the finding of rubber substitutes for Ranger engine parts. Among the tests noted are chemical, flexing, tensile strength, heat and cold, and fuel and oil tests, as well as tests to determine the point of ultimate elongation. Several characteristics common to all the synthetics used in Ranger engines are listed. Attention is given to the fact that the work was conducted by a woman biochemist who is also reported to have made engineering changes for the accommodation of parts. *The Pegasus*, February, 1944.

Field Servicing and Maintenance Equipment Made from Second-Hand Cars

The Ryan School of Aeronautics developed several field-service utility items by redesigning and adapting used cars and other available equipment.

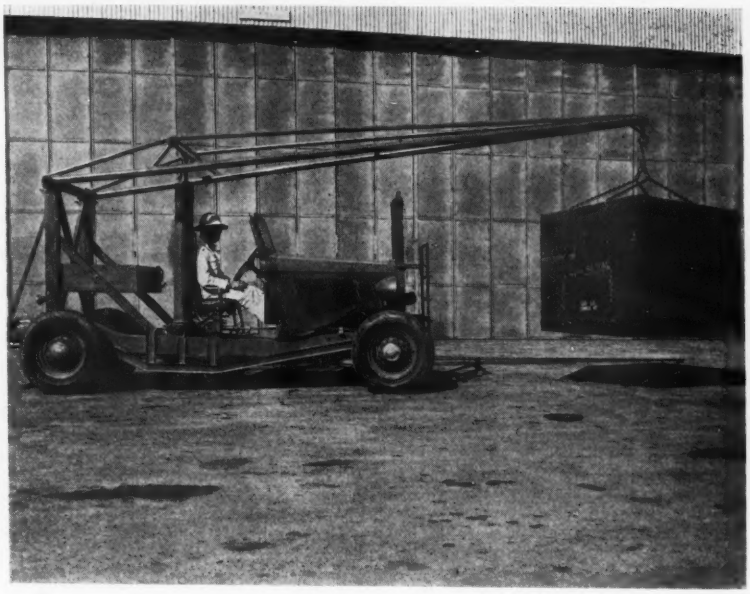
Three items in particular—the Ryan Handy-Man Hoist Car, Tow Cars, and Gas Truck Boom—are described in technical bulletins prepared to assist other civilian and military operators in the construction of similar equipment. Instructions are given, with the aid of drawings and photographs, for the structural alterations and the installation of equipment needed to transform second-hand automobile chassis into useful pieces of field-service apparatus for lifting and moving heavy units, for towing airplanes, and for filling the tanks of aircraft while at different points about the airport. *Ryan School of Aeronautics*, Hemet, Calif., and Tucson, Ariz.

Gauges to Show Liquid Levels

Liquid-Level Indicating Equipment for Aircraft. Designed to assist in the selection and application of both transmitters and indicators, this is a manual on General Electric's remote-indicating liquid-level equipment for aircraft. The detailed descriptions of the apparatus are supplemented by cutaway drawings that help to explain the construction, application, and theory of operation. There are four separate sections in the book: The first deals with Type TJ-13 transmitter; the second, Type TJ-17 transmitter; and the third, Type TJ-18 transmitter—each with associated indicators. The last section covers the calibration of tanks. *General Electric Company.*

Communications Equipment in the War

Battle Talk. A picture-magazine type of booklet records the highlights of Western Electric attainment in the communications equipment field and the story of the company's production since the year before the attack on Pearl Harbor. By means of action photographs, drawings, diagrams, and text, *Battle Talk* depicts the role played by Western Electric equipment in combat incidents on land and sea and in the air. Though a large portion of the book is devoted to the story of equipment in action, it also illustrates the activities in the war plants that are producing electronic and communications equipment for war. Among the specific items covered are air-borne radio apparatus, quartz crystals, electrical gun directors, and telephone equipment for use in the front lines of combat. *Western Electric Company, Inc.*



The Ryan Handy-Man hoist car for aircraft field service.

Grumman Production

Home of the Hellcat. Some examples of the Grumman Aircraft Engineering Corporation's resourcefulness in fabricating methods and handling of materials are given. Among the phases of Grumman production referred to in the article are wing-strut manufacture, fabrication of the accessory-compartment baffle, holding of material specifications to a minimum of grades, the gradually increasing use of carbon steels, heat-treating of metals, the simplification program on stainless-steel sheets, and the transition from forgings to castings, wherever possible. *Steel Horizons*, Vol. 6, No. 1.

Establishing an Asiatic Base

Burma Roadsters. The story of how American Airlines established an air base in India from which supplies could be flown into China. Supplementing the description of problems encountered is the report that during the four months of operation by the air line, until the route was taken over by the Army, 1,075 trips were made along the "Burma Road of the Air" and almost 5,000,000 lbs. of cargo—mostly bombs and gasoline—were transported into China. *Flagship News*, February, 1944.

Standard Stock Blanks for Thread Milling Cutters

A six-page descriptive folder, CB-43, lists over 50 standard blanks for thread-milling cutters. Ready for thread grinding to users' specifications, these blanks constitute sizes and types for cutters most commonly used in the aircraft industry. All blanks are finish-machined, heat-treated, spiral-fluted, and ground to a 5° rake angle. Both shell type and shank type with three standard types of tapers are included. *Detroit Tap and Tool Company.*

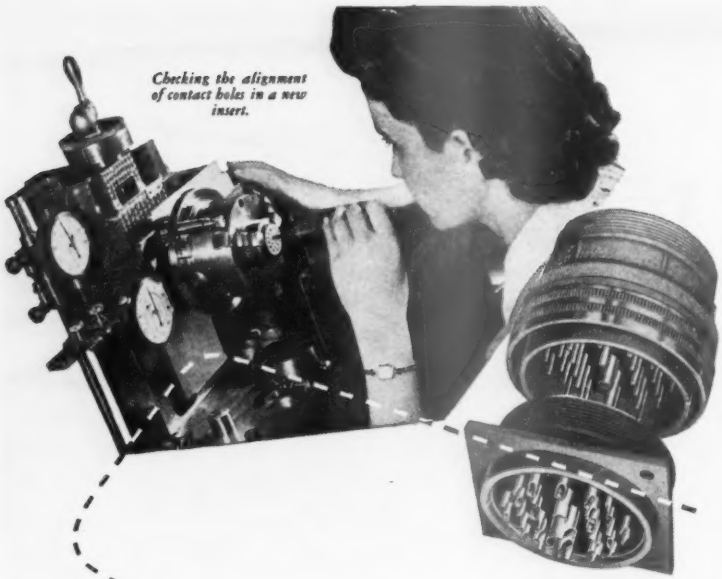
Turbosupercharger

They're Turbosupercharged. One of a series of booklets on General Electric's history and research activities, this publication is concerned with the company's turbosupercharger. In it is the story of the result of 40 years of research and development. The construction of the turbosupercharger is described, and the operation of the turbosupercharger is explained. Pointing out differences between the turbosupercharger and the geared supercharger, the booklet also lists the advantages of the supercharger for high-altitude flight. Part of the text is allotted to a report of the work done by Dr. Sanford A. Moss in pioneering the development of the supercharger. *General Electric Company.*

Laminated Wood Propellers

Propellers from "Pregwood." J. Roger White. An account is given of how light, strong propeller blades are being produced from sheets of maple veneer uniformly impregnated with Bakelite phenolic resin, laminated under heat and pressure into a composite structure. It is explained that new plant facilities have made possible the manufacture of an improved blade made from "Pregwood" boards.

New techniques used in the manufacture of propeller parts are described and illustrated. *Bakelite Review*, January, 1944.



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To Cannon men and women, however, quality control means a *thousand things*—the constant vigilance to innumerable details —the continuous betterment of design—the alert scrutiny of materials—the steady improvement of machines, tools and methods—the checking, testing and checking again of all the parts as well as the completed product.

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An important training aid "Soldering Tips," a 25 minute slide film with sound, giving step-by-step procedure in soldering contacts... a companion film for "The Quick Disconnect," available on request. Contact your Cannon Representative or write direct to the Cannon Factory, Dept. A-105.

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Oil Company's Services to Aviation

The Kind of Faith on Which Great Industries Are Built! The activities of the Phillips Petroleum Company on behalf of aviation development are recounted. In addition to conducting studies and tests for higher performance aviation fuels, the company has loaned its planes for research on delayed-opening parachute jumps, has conducted research analysis for combating carburetor ice formation by preheating air taken into the induction system, and has sponsored racing pilots as well as experimenters in stratosphere flight. It is noted that the Phillips company has maintained a small fleet of airplanes for transacting its own business, has made extensive use of aerial photography in the preparation of surveys, and has its own airport at Bartlesville, Okla. *Global Service Log*, Third Quarter, 1943.

Series of Aircraft Accessories Bulletins

Aircraft power-supply equipment and aircraft ice-elimination equipment are the respective subjects of Eclipse Products' first two "Aviation Accessory Design Check Charts." Chart No. 1 is a 4-page folder describing the application, performance, and design of high-speed, engine-driven generators and carbon-pile voltage regulators. Chart No. 2 is devoted to descriptive and factual data on manifold-solenoid deicer systems with electronic controls. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Steel Cutting with Carbides

A guide to top performance in steel cutting with carbides has been issued in booklet form. Designated as *Manual GT-166*, the booklet includes the characteristics of different grades of carbides designed for steel cutting, selection of proper rake and relief angles, size of radius, etc.

Major considerations as to machine requirements, speeds, and feeds are given, together with grades recommended for different classes of steels. The design and grinding of chip breakers and the problem of supplying coolant in proper amounts and properly directed are included.

The 16-page manual concludes with operating hints on carbide tools. Of particular interest are the trouble-shooting suggestions to be followed in case of tool chatter. *Carboloy Company, Inc.*, Detroit.

Improving the Optical Qualities of Plastics

An Idea . . . with a Future. This article deals with the development of a method for eliminating "mark-off" in plastic forming. Devised by Bell Aircraft employees, the invention is based on the principle of mechanically moving the hot sheet back and forth while the plastic is being formed. *The Bellringer*, January, 1944.

From the Industry

Aircraft Hydraulic Filter

A new precision proprietary filter is now in production for hydraulic systems of large aircraft. Designated as the "Micronic Filter" because it filters particles of 5 microns and larger to meet the requirements of Army and Navy specifications, this new filter operates from −65° to 165°F. The filtering cartridge itself expands and contracts with the varying temperatures encountered.

One model measures 6 by 8½ in., weighs 2 lbs., and has 3,800 sq.in. of filtering area. Rated output is 1,800 gal. per hour at 100°F., with pressure drop of only 16 oz., filtering AN-VV-O-366a hydraulic fluid. The inlet opening is 1½ in. in diameter, and the filtering flow may be arranged for either direction.

An automatic pressure relief is incorporated to by-pass the full flow of liquid at any predetermined pressure setting should line surges peak beyond a safe point. Although the filter operates in any position, generally accepted aircraft practice locates the 1½-in. opening at the bottom.

Dural alloy is used for the metal parts of the filter, but tooling is arranged to permit the use of other alloys, such as stainless steels, for other applications. Filters are also available in 2- and 4-in. sizes with capacities of 450 and 900 gal. per hour, respectively. Adel Precision Products Corporation, Burbank, Calif.

Aeronautical Chamber of Commerce Postwar Program

As a result of the conference of the Airplane Technical Committee of the Aeronautical Chamber of Commerce, held in St. Louis, the following program was adopted for the purpose of promoting postwar and private flying on a sound technical basis: (1) Establishment of an "Air Worthiness Requirements Committee" to develop efficient design standards for private and commercial type airplanes; (2) passage of a resolution for simplification of Government approval of airplane designs; (3) endorsement of United States participation in discussion with foreign countries leading to the establishment of uniform, basic safety standards for aircraft; (4) obtaining of statistical data from current military operations of aircraft as a basis for improving the efficiency of both civil and military aircraft. Aeronautical Chamber of Commerce of America.

Helicopter-Engine Details

Details have been released on a new model of Franklin aircraft engine designed and built to power postwar rotating wing aircraft. The engine is a six-cylinder, horizontally opposed, air-cooled type, mounted vertically directly below the main rotor shaft. Cooling is accomplished by an engine-driven fan covered by a large air housing, which also conceals a clutch mechanism serving to disengage the engine from the rotor.

The maker states that, besides the fan, the principal difference in this engine from the conventional Franklin aircraft engine is in the oiling system, which has been completely redesigned.

The present model has been used in experimental installations in helicopters developed by several of the major aircraft companies. While not in production at the present time, it is stated that it can be produced in quantity within a short time following the end of the war, since its basic design is so similar to that of the conventional Franklin aircraft engine. Aircooled Motors Corporation, Syracuse, N.Y.

In-Plant Labor Pool

A system of in-plant "labor pooling" has been devised by West Coast aircraft manufacturers. This provides for the exchange of labor from one department to another in order to reduce the loss of man-hours caused by factors over which management normally has little control. If material shortages schedule revision, changes in specifications, or other such causes should make workers temporarily idle in one section of a plant, the labor dispatch system routes or loans them to departments that for any cause, such as absenteeism or the increasing difficulty of hiring direct workers, have a shortage of help. The plan is typified by the labor pool maintained at the Santa Monica plant of Douglas Aircraft since January, 1943, but action to extend the system has been taken. Aircraft War Production Council, Inc.

Fire-Extinguisher System

The Alfite Alneumatic aircraft fire-extinguishing system is designed to protect not only the remote engine compartments, oil coolers, and exhaust stack wells but also the accessory compartments of the nacelles. An important feature of the system is the compact mechanical operating head attached to the cylinder containing the extinguishing agent. It includes a small hollow needle, operated by a manually controlled cable that pierces a sealing disc, releasing gas pressure within the head. This in turn depresses a large main cutter that instantly releases all the gas. Pressure of the gas in the cylinder is used to operate the large cutters. The system's pilot valve provides instant direction of the discharge to any point in the plane.

The nonmetallic disc that directs the discharge is pressure-tightened against the valve body by gas. The system head is not a spring-loaded device but functions entirely by gas pressure. An auxiliary head operates on the same principle. Heads are attached to the cylinders by means of a swivel nut to facilitate maintenance. American-La-France-Foamite Corporation, Elmira, N.Y.

Automatic Mil ing Machine Vise

The Bellows CVH-60 automatic milling machine vise, by eliminating all hand clamping and by synchronizing opening and closing of the vise jaws automatically with the movemnt of the machine bed, is reported to cut loading and unloading time as much as 40 per cent.

Utilizing the maker's Senacon air motor, operating through predetermined leverage, the new vise will provide clamping pressures ranging from 1 lb. up to 40,000 lbs. Clamping pressures are applied by the finger-tip control valve, integral with the vise. Any desired degree of pressure may be applied and maintained exactly throughout the day's operations.

Vise jaw opening is adjustable through 4½ in., although the moving jaw moves only ⅞ in. at the full extent of the stroke. The double-acting valve, integral with the vise, is equipped with a universally adjustable finger-tip control permitting operation of the valve from "any angle in any plane." The control lever may be synchronized with any moving part on the milling machine to provide fully automatic opening and closing of the vise. The vise is equipped with an automatic oiler that bathes all enclosed parts and linkage with an oil mist from the motor exhaust. The Bellows Company, Akron, O.

Machining Aircraft-Engine Valves

Virtually automatic machining of Stellite and steel simultaneously with the same cutting tools on a quantity-production basis is being accomplished

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BALDWIN ROLLER CHAIN BELTS FOR AVIATION . . . .

by Thompson Aircraft Products Company through the use of Carboloy cemented carbide tools. The process is employed in making a special steel aircraft-engine valve with Stellite applied to the outside diameter of the head and seat. The method adopted for the finish machining of this piece is as follows:

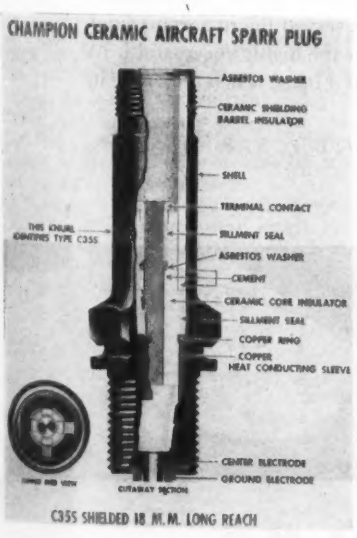
The part is machined on a Sundstrand automatic stub lathe having a front and rear tool slide. The front slide carries a Carboloy turning tool, while a Carboloy forming tool for finishing is mounted on the rear tool slide.

The valve is held on the stem end by means of a collet in the work spindle and supported at the head and by the tail stock center. The operator pulls in the tailstock with a handle that also locks the tailstock. This lever movement also actuates a switch mounted on the tailstock, which starts the spindle as well as the feed of the two slides. In this way the operator has a minimum number of operations to perform. Actually, he merely loads and unloads. Feed is automatic and the machine stops when the cycle is completed.

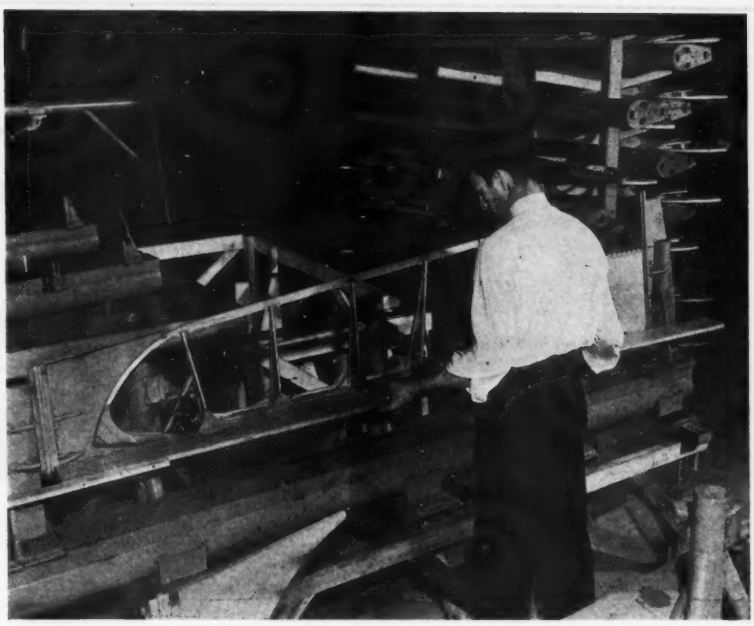
The carbide turning tool makes its cut across both the steel and the Stellite surfaces at the same speed of 80 ft. per min. The instant that the tool clears the work, the forming tool comes in for the finishing plunge-cut. Carboloy Company, Inc., Detroit.

Spark-Plug Construction Chart

Construction and structural features of four types of Champion ceramic aircraft spark plugs on a scale eight times that of actual plug size are depicted in a series of four charts now being distributed to Army, Navy, and technical training schools. These charts are accurate in scale and color and give the student mechanic an exact picture of important structural and operative features. The charts are made with tinned



One of the charts issued by the Champion Spark Plug Company for use in the instruction of engine mechanics.



Through the use of a gauge, this Consolidated Vultee inspector can check an elevator for a BT-13a in a fraction of the time that would have been required by setting up a surface plate and checking to blueprints.

self-hangar tops and dowelled bottoms on cloth-backed stock for classroom use. Champion Spark Plug Company.

Electrically Induced Coating for Magnesium Alloys

Discovery of a protective coating enhancing the use of magnesium in the construction of large aircraft is reported by Consolidated Vultee Aircraft Corporation. The electrically induced coating is described as an anodic film that makes magnesium alloys as noncorrosive and abrasion-resistant as aluminum alloys. It is stated to be extremely tight and resistant to electrical current and abrasion. The ability to withstand the potential of 110 volts, together with its resistance to wear and its impervious surface, accounts for its corrosion-retarding characteristics.

The company claims that accelerated tests show that when magnesium alloys are coated with the new finish they hold up as well as, and in some cases better than, anodized duraluminum. This is supplemented by the statement that the abrasion resistance is 50 to 100 times superior. A postwar factor is the high degree of smoothness of the finish and the possibility that dyes can be introduced into the anodic solution with subsequent production of a wide variety of colors. Consolidated Vultee Aircraft Corporation.

Self-Adjusting Toggle Clamp

A small portable clamp that automatically adjusts itself to varying thicknesses of work measures only $7^1/_4$ in. in overall length and is particularly suited to jobs where space limitations prevent the use of larger tools. Its range of adjustment is from 0 to $^3/_8$ in. This clamp is designated as Model 462 and is built of pressed metal parts, with rust-resisting finish. Detroit Stamping Company, Detroit.

New Aircraft Accessory

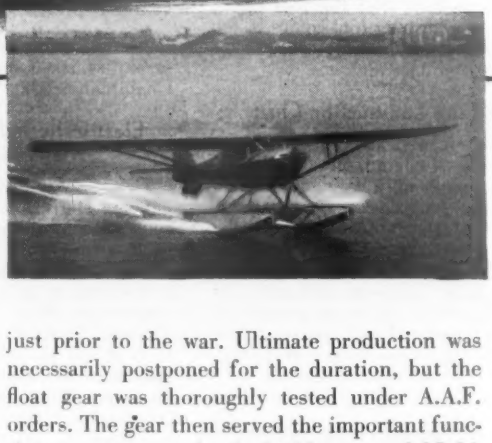
A complete 400-cycle blower unit includes a No. 2 L-R blower and a J31A, $^1/_{100}$-hp., single-phase capacitor motor. Overall measurements are $4^7/_{32}$-in. length, $3^3/_4$-in. blower diameter, $1^{15}/_{16}$-in. motor diameter, and the weight is $19^1/_2$ oz.

Running at 7,200 r.p.m., the blower circulates 22 cu.ft. per min. continuously. The motor is designed for use in ambient temperatures up to 80°C. J31A motors are also available for use in other applications. Eastern Air Devices, Inc., Brooklyn.

Eclipse "Series 43" Inertia and Direct-Cranking Electric Starters

The "Series 43" inertia and direct-cranking electric starter is designed to provide high initial cranking speed, followed by direct cranking, for aircraft engines of 450 to 1,200 hp. having piston displacements of approximately 679 to 1,860 cu.in. They are intended for installation on aircraft engines incorporating a 6-in. S.A.E. starter-mounting pad, and are available for 12- or 24-volt d.c., one-wire grounded operation, with either a 3- or 12-tooth jaw for left- or right-hand rotation. The starter mechanism consists of a heavy-duty accelerating and direct-cranking electric motor, balanced flywheel keyed directly to the armature shaft, reduction gearing consisting of a four-planetary gear set and two stages of spur-gear reduction, adjustable multiple-disc clutch, engaging mechanism, baffle plate, and starter jaw.

The LIGHT PLANE, too, has an AMPHIBIOUS future



Here's a Taylorcraft on experimental Amphibious Floats that work well on both land and water.

A non-retractable bow skid, proportioned to create hydro-dynamic lift when in contact with the water, takes the place of the retractable bow wheel used on larger models. The only retractable parts are the main wheels, cable operated by a direct acting hand lever . . . fast acting, and like the bow skid, simple in arrangement, saving in weight, cost and maintenance.

This light plane Amphibious Float development was undertaken as a commercial program just prior to the war. Ultimate production was necessarily postponed for the duration, but the float gear was thoroughly tested under A.A.F. orders. The gear then served the important function as a prototype for the highly successful L-1A and C-47 Amphibious Floats which followed it.

EDO AIRCRAFT CORPORATION, 413 SECOND STREET, COLLEGE POINT, L. I., N. Y.

EDO
AMPHIBIOUS FLOATS
with retractable wheels

★ **EDO FLOAT GEARS** ★

SERVE THE UNITED NATIONS

Assuming a nominal engine cranking torque of 225 lb. ft., the "Series 43" electric starters will provide an initial cranking speed of 110 r.p.m. followed by direct cranking at 35 and 48 r.p.m. for 12- and 24-volt starters, respectively. Both the inertia and direct-cranking features are used for normal operations; the direct-cranking feature only for warm-engine starting; the inertia feature only when batteries are low; and hand cranking for emergency starter operation.

A brush-spring tension-release mechanism permits release of the brush-spring tension when hand cranking of the starter is desired, and an integral solenoid relay provides remote electrical control of starter jaw engagement. The multiple-disc, dry, friction clutch, sealed to prevent entrance of engine oil into the clutch pack, protects the starter in the event of undue loading. The starter is concentric in design, 7 in. in diameter, 11¼ in. long from mounting flange to backhead. The weight is 32 lbs. for the 12-volt unit and 33.9 lbs. for the 24-volt unit. Eclipse-Pioneer Division, Bendix Aviation Corporation.

Eclipse-Pioneer Servo Control Systems

Eclipse-Pioneer has developed a series of aircraft servo motors for application where positive straight-line or rotary motion with or against opposition is required. In conjunction with autosyn transmitters and amplifiers, all interconnected, control systems can be designed for specific applications to provide remote automatic and coordinated control of aircraft main engines, elevator, rudder, and aileron-control surfaces.

Several motors have been designed to provide for the following requirements: (1) straight-line motion; (2) rotary motion; and (3) continuous rotary motion. Eclipse-Pioneer Division, Bendix Aviation Corporation.

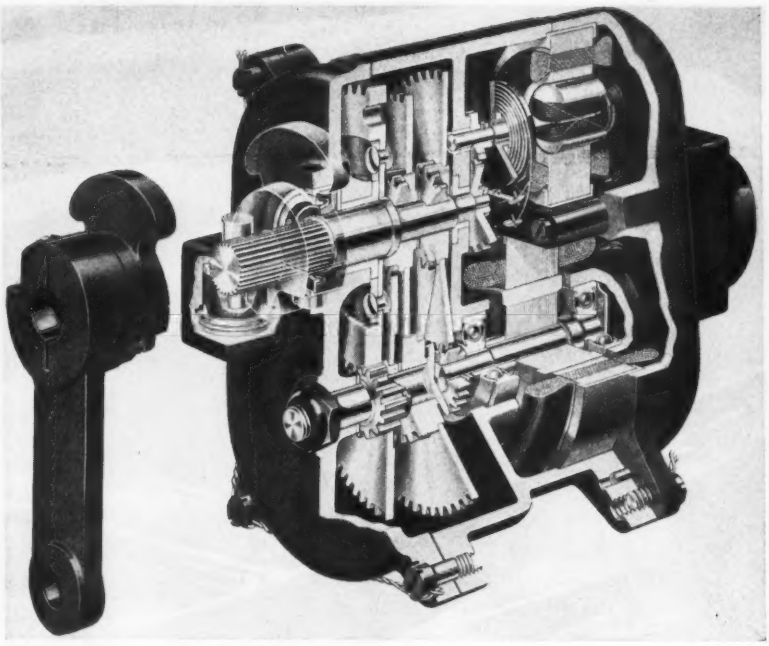
Revised Fairchild Utility-Cargo Plane

Flight tests are now being conducted on a revised utility-cargo airplane that has just been completed. The revised model, designated as the Fairchild UC-61K, is similar to the four-place UC-61A but is powered by a Ranger 200-hp. in-line engine instead of the 165-hp. radial engine formerly used.

Wing area is 193.3 sq.ft. with a span of 36 ft., 4 in. The overall length has been increased to 25 ft., 10¼ in. General construction, interior arrangement, and other details are identical to those of the UC-61A "Forwarder," which will continue in production in the immediate future at Fairchild. The UC-61A is reported to have seen service in Africa, England, Australia, and on other fronts as a liaison plane and personnel and light cargo transport. Fairchild Aircraft Division, Fairchild Engine and Airplane Corporation.

Cutting-Oil Compound

A cutting-oil compound for use in cutting hard, high-speed tool steels, chrome molybdenum, and the new National Emergency alloys is a mixture of animal oil and other chemical ingredients and was developed for tapping chrome molybdenum nuts and other parts. It has been used on high-speed steels, heat-treated alloy steels of various types, and in the threading of Dural parts. Fearless Oil Company, Los Angeles.



The Eclipse engine-control servomotor.

Aircraft Fire Detectors

A continuous type and a new unit-type fire detector for use throughout aircraft are designed primarily for engine and accessory sections. The continuous type is in the form of a fusible-alloy tube, copper plated, containing inorganic insulating beads that support a conductor wire. This, when mounted on an engine or installed throughout a plane, gives instantaneous warning to the pilot for manual operation of fire-extinguishing equipment.

Flame applied to the assembly causes the tin alloy to melt, filling the spaces between adjacent beads, thereby completing the circuit between the conductor wire and the grounded tube. The circuit completed in this manner is used to actuate either a signal light or other alarm.

The unit type uses the principle of the manufacturer's Thermoswitch, in which the temperature-detecting unit is based on the expanding shell that separates two silver contacts carried on curved Invar struts under spring tension. Contacts may be arranged either to open or close the circuit on temperature increase as required. This type is frequently used in conjunction with the continuous type for isolated spots. Fenwal Incorporated, Ashland, Mass.

Lever-Type Speedichuk

A feature claimed for the new Lever-Type Speedichuk is that it not only increases the collet capacity of ½-in. lathes to ¾ in. but allows the work to be chucked, fed, machined, and released without stopping the lathe.

Fitting any one of several makes of 9-in., 10-in., or 12-in. lathes, as well as any other 1½-in. by 8-thread spindle lathe having a No. 3 Morse Taper on the inside, the chuck requires no drilling or tapping. It is ready for instant use and is interchangeable on any lathe of conforming spindle without impairing its accuracy. The floating closing sleeve compensates for any misalignment of the lathe spindle, and hardened rollers reduce friction to a minimum. All parts are hardened and ground. The design is possible because it is built for use with the Bren Collet, whose body ends in a No. 3 Morse Taper and which is held firmly in the lathe spindle. General Die-Stamping-Tool Company, New York.

Current-Regulating Compensator

A new current-regulating compensator for resistance welding machines is designed to facilitate consistent welds by holding the true heating value of the weld current constant for any heat-control setting, without requiring continual manual adjustment.

After the predetermined heat-control setting for a particular job has been made on the compensator, it requires no further adjustment. It is stated that it will hold the welding current to a variation of plus or minus 2 per cent under the same conditions that would cause the unregulated welding current to vary plus or minus 20 per cent.

Mustangs Raise Hell in Heavens

Seven miles upstairs, Yank pilots ride the wings of fierce-charging Mustang fighters, dealing death to Nazis desperately trying to intercept our high-altitude heavy bombers. Here in the arctic cold of the stratosphere a chronicle of victory is sky-written by white vapor trails and by the searing flame of an enemy plane in its last screaming earthbound plunge. The men and women of North American Aviation are proud of the "angels from hell" who pilot these avenging P-51 Mustangs—proud, too, of their own vital part on America's production front.

North American Aviation *Sets the Pace*

We make planes that make headlines . . . *The B-25 Mitchell bomber, the AT-6 Texan combat trainer, the P-51 Mustang fighter (the A-36 fighter-bomber), and the B-24 Liberator bomber. North American Aviation, Inc. Member, of the Aircraft War Production Council, Inc.*

The compensator consists of an electronic control that automatically retards or advances the firing point of the ignitron tubes used to control the welding current, thereby holding the current constant regardless of line voltage changes or welding conditions. General Electric Company.

Automatic Fixture Speeds Flame Treatment

An automatic fixture has materially speeded the operation of surface-treating small laminated aircraft-instrument motor cores with an oxidizing flame.

Previously done manually, the operation required the movement of a small, high-temperature gas flame across and around the core. This was not only slow but difficult, inasmuch as the movement of the flame had to be steady in order to destroy small burrs and properly treat the surface.

The automatic fixture uses a welder's torch mounted on a sliding block driven by a crank wheel. The core is placed on the rolls, which rotate it at a speed that permits the crosswise travel of the torch to carry the flame back and forth along the slots and surface. The core is allowed to make two or three complete revolutions and is removed. General Electric Company.

Bending and Stretching Metal Aircraft Parts

The Roto-Stretcher is a machine for bending and stretching metal parts for aircraft with speed and economy. It forms parts without wrinkles because of the controlled force it exerts during operations.

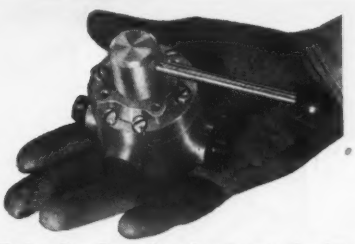
Only one man is required to operate the apparatus, and the first machine installed is reported to have paid for its development and cost in a single week's operation. It is stated that parts can readily be formed on the Roto-Stretcher which previously had to be formed in conventional mechanical dies. Springback is negligible. The machine is being used to form parts with contours up to 360°. Goodyear Aircraft Corporation.

New Engine Mount

A lighter engine mount containing less rubber has been developed for the Flying Fortress. It is stated that the new design permits the Flying Fortress engines to reach their vibration peak much earlier and that this aids in the more accurate aiming of bombsights and guns. The engine vibration is absorbed by a natural-rubber sleeve. The knuckle of the mount is made of a plastic that eliminates the need for lubrication. The new engine mounts are interchangeable with the older type. Goodyear Tire & Rubber Company.

Aircraft Relay

A solenoid-type 50-amp. aircraft relay has been developed for controlling circuits for landing lights, fuel pumps, gun-firing controls, etc. Its weight is below 0.6 lb. The makers claim that it will withstand a surge load of 400 amp. without injury to the contacts and that it will withstand vibration of 5 to 55 cycles per second with a total excursion of $^1/_{16}$ in. in any direction. The Hart Manufacturing Company, Hartford, Conn.



Hydraulics, Inc., directional control valve.

Hydraulic Control Valve

A newly developed hydraulic directional control valve weighing only 13 oz. is designed to operate under a pressure of 3,000 lbs. per sq.in. with a maximum handle torque of only 20 in.lbs. This low handle torque in comparison with the high operating pressure has been accomplished by special design.

The valve is of semibalanced poppet type and is so designed that excessive pressure in the cylinder lines caused by thermal expansion of the hydraulic fluid has no effect upon the operation and handle torque of the valve. It is also stated that back pressure caused by the valve being partially open does not add to the handle torque.

Because a rotary disc type of cam is used, the valve may be readily operated by a small electric motor. The electrically driven valve is available for 24-volt, 3-amp., d.c. circuits and 200-volt, 400-cycle, a.c. circuits. The valve is capable of opening in $^1/_2$ sec. when motor-driven and, consequently, is suited for the control of hydraulically operated flaps, slots, and other actuating purposes in aircraft. Hydraulics Inc., Pasadena, Calif.

Tube Cutter for Aircraft Work

A tube cutter—specifically developed for aircraft work and designed to make the clean, right-angle cuts essential for AN-type flares—cuts aluminum, aluminum alloy, copper, brass, or steel aircraft tubing in sizes from $^1/_8$- to $1^1/_8$-in. outside diameter.

Advantages of this cutter for aircraft-tubing connection work claimed by the manufacturer include the following: Handles a wide range of tubing sizes; tubing rests against two rollers to prevent galling or rubbing; a special flare cutoff groove in the rollers enables the operator to remove a damaged flare with a minimum of waste and frequently eliminates replacing the tubing. This flare groove is designed to handle AND-10061 flares on tubing up to 1-in. outside diameter; a convenient reamer for removing burrs is a part of the tool. Telescope-type, enclosed feed mechanism protects threads against dirt and damage, and overall length of tool remains the same regardless of size of tubing being out. Fine feed thread permits gradual application of cutting pressure, protecting against gouging or egg-shaping of tubing. This tool is designated as No. 212-F aviation tube cutter. The Imperial Brass Manufacturing Company, Chicago.

Brake-Drum Truing Machine

An aircraft brake-drum truing machine has been designed to meet the specific needs of military aircraft maintenance, many of which apply equally to civil aircraft. A squirrel-cage induction-type motor is used to eliminate the danger of sparks from brushes. Magnetic starter switches, special cones to fit aircraft drums, and silencers are other features of the machine. To change from turning to grinding or vice versa, the operator merely has to rotate the turret, which contains both the turning tool and grinder. Lempco Products, Inc., Bedford, O.

Weld Inspection Chart

A comprehensive arc-welding inspection chart, designed so that operators and inspectors can tell at a glance whether welds are being properly made, has been completed. It pictures actual specimens of various results obtained in making fillet and butt welds and describes briefly the appearance and characteristics of proper and improper weld beads, with a description of the conditions under which each was made.

A portion of the chart is devoted to a description of the "Fleet-Fillet" welding technique, telling of its advantages and where and how to use it. A table on the procedure for single-pass horizontal and positioned fillets with "Fleetweld 11" carries data such as electrode sizes, desired current, burn-off rates, and arc speed.

The chart is printed in two colors on a heavy grade of stock measuring 23 by 35 in. and is available without charge to inspectors, operators, and others concerned with welding. The Lincoln Electric Company, Cleveland.

Simplified Work Holder

A simplified type of fixture for holding small flat work for toolroom use and certain other types of production operations have been developed to overcome difficulties encountered in drilling, countersinking, and tapping small precision parts in which perpendicularity is essential. The fixture may also be used for many operations on shapers and bench milling machines. Mead Specialties Company, Chicago.

Name Change Reported

The Meriam Company, Cleveland, manufacturer of instruments for measuring purposes, has changed its name to the Meriam Instrument Company. Meriam Instrument Company, Cleveland.

A New
RECOGNITION LIGHT SWITCH BOX
SMALLER—STURDIER
EASY TO INSTALL
EASY TO REPLACE

Constant production of Electrical Junction Box Assemblies to aircraft manufacturers' specifications has developed an awareness in our Engineering Department of opportunities to improve standard units. This results in the design and development of units such as the one pictured.

This unit takes its place with our steadily growing schedule of production of Junction Box and Wiring Assemblies for Aircraft, all made by Unionair under our Single Responsibility.

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Junction Box Assemblies — Hydraulic Fittings
Conduit Fittings — Junction Boxes

UNION AIRCRAFT PRODUCTS CORP., NEW YORK

Northwest Aviation Exposition

Plans are being advanced for an aviation exposition at the Minneapolis Municipal Auditorium March 25 to April 1, inclusive. To be known as the First Annual Northwest Aviation Exposition, the event has the sponsorship of the Great Twin Cities Chapter of the National Aeronautic Association.

Convention sessions of airport managers, base operators, and flight instructors are being planned for the dates of the show, and efforts are being made to provide for an exhibition of planes to include models currently in use by the armed forces, as well as models captured in Europe and the Pacific. Headquarters for the exposition are at 326 Radisson Hotel, Minneapolis. National Aeronautic Association, Greater Twin Cities Chapter.

Fluxrite Fluxed Wire Solder

Fluxrite fluxed wire solder contains flux in longitudinal grooves on the surface rather than in the core. The manufacturer explains that, since the flux in the new product is outside rather than inside, it liquefies and flows onto the work before the solder melts.

In addition to prefluxing, the new solder also is claimed to provide an unbroken flow of flux. Since the new product has more than one flux-filled groove, there is a tendency toward a continuous flow at all times.

An additional advantage claimed comes from the fact that as the flux supply is outside the wire it is always visible to the user and can be checked quickly and readily. National Lead Company, New York.

Study of Aircraft Standardization

Standardization of Aircraft Tubing is the title of a study made by engineers of the National Tube Company. It traces the history of the development of these special grades of steel and alloy-steel tubing and the work that has been done in standardizing this class of material. The advantages obtained from the standardization of manufacture, warehousing, and delivery are reviewed, indicating economies that have been effected in both cost and time as a result of the standardization work that has been accomplished. National Tube Company, a Subsidiary of United States Steel Corporation.

Northrop P-61 Black Widow Night Fighter

The Northrop P-61 Black Widow night fighter is described as the first to be designed specifically for night fighting. Planes heretofore used for night battling have been modifications of aircraft originally planned for other types of tactical missions.

Design of the P-61 was started in 1941 at the request of the Army Air Forces, who laid out the list of requirements for a night fighter based upon the lessons learned in Europe. With these essentials in mind Northrop engineers laid

ADVANCED TIME-SAVING METHODS

● Heavy bomber motor mounts are kept in the same holding fixture throughout all machining operations. This is typical of our advanced methods that save time and assure the utmost precision in the manufacture of welded steel tube, tubular parts and assemblies for the aircraft industry.

AMERICAN METAL PRODUCTS COMPANY

5959 LINSDALE AVENUE, DETROIT 4, MICHIGAN

How globe girdling pilots keep their feet on the ground...

Vacuum tubes mark the roadways of international air transport. This is no fantastic dream... these tubes are in service today... the signposts which point the three dimensional way from port to port around the world in every direction.

Certainly, it takes courage and skill, fine aircraft and good runways to maintain scheduled flights. But never forget the importance of communications, air beacons and instrument landing. Never forget the control centers around busy airports. Electron vacuum tubes are the nerve centers of all this equipment and the nerve centers that make the operation of world-wide airways practical. It is this equipment that, figuratively, keeps the pilots' feet on the ground.

Eimac tubes are the outstanding favorites for these services. First choice of the airlines, first choice of leading electronic engineers throughout the world and first in the important new developments in radio.

Follow the leaders to

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TUBES

At every outpost of world-wide air transport Electron Vacuum Tubes stand guard. Illustrated is the Eimac 450T

EITEL-McCULLOUGH, INC., 799 San Mateo Ave., SAN BRUNO, CALIF.

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out the XP-61 prototype, which was first test-flown from Northrop Field on May 26, 1942. Production at the Hawthorne plants of the company is now concentrated on the manufacture of the new P-61.

The Black Widow is reported to be equipped with the latest equipment for night fighting. Powered by two Pratt & Whitney engines, it develops pursuit speed while retaining the easy flying characteristics and low landing speed necessary for night operation.

Simultaneous with official Army announcement of its existence, the P-61 made its first public appearance at the Army-Navy Show staged for war workers at the Los Angeles Coliseum on January 8. Northrop Aircraft, Inc.

Oakite Compound No. 86 for Cleaning Steel

Specially designed to facilitate the preparation of steel for organic finishing by providing improved adhesion of the subsequent coating of paint, lacquer, or other finish, an acid-type detergent, heretofore restricted to plants doing war work, has been released for use in all metalworking plants.

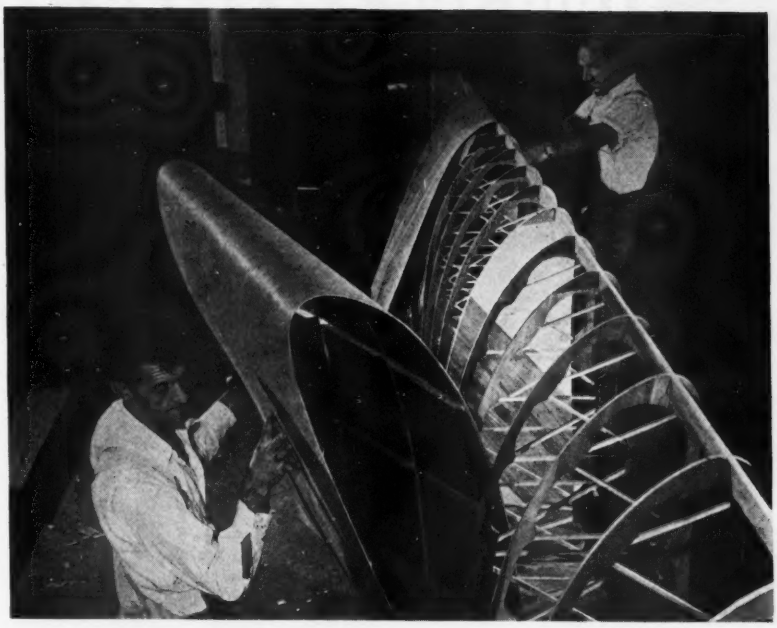
This development, known as Oakite Compound No. 86, is intended to perform three functions in one operation: (1) Its detergent action removes light spinning compounds, drawing lubricants, machining oils, finger marks, shop dirt, etc., so that preliminary alkaline degreasing, often previously required, is eliminated; (2) the material also conditions the surface as it cleans, imparting a microscopic crystalline protective coating on work to assure firm bonding of the finish; (3) the coating also acts as a rust inhibitor and protects parts against rusting between operations. Oakite Products, Inc., New York.

Mobile 7½-Kw. Tocco Induction Machine

Departing somewhat from the conventional design of high-frequency units, a new 7½-kw. output Tocco Junior induction heating machine features a work unit separate from the power unit. If desired, the mobile top can be moved to facilitate shop operations. It is connected to the power unit by a cable that need not be limited as to length.

The new unit provides a wide range of induction heating for brazing, annealing, heating for forming and for hardening small parts. Because it is especially designed with the brazing of carbide-tip tools in mind, the small machine is suited for use in a shop toolroom. In the production line the unit will serve as a utility "heat-treating department" operating economically in numerous ways.

The 30- by 36-in. power or lower unit, which stands 30 in. high, contains the motor generator, cycle controls, air filters, and operating meters. The timer and field control switches are located on the side of the cabinet. In the work or upper unit, which measures 20½ by 17 in. and stands 16⅜ in. high, are housed the high-frequency transformer, condensers, and the panel to which can be attached the work fixtures or inductor coils. For surface hardening the work unit will contain quench valve, manifold, and gauge. A stop-and-start push button with signal light is situated in the upper right-hand corner of the unit. The Ohio Crankshaft Company, Cleveland.



The leading-edge nose skin of a CG-4A plywood glider is installed at the Weber Showcase and Fixture Company.

Position-Light Flasher

A position-light flasher (12-volt model 3990 and 24-volt model 3990A), developed by the Pacific Division of the Bendix Aviation Corporation, is now in use on United States air liners and on Army trainer planes. Designed exclusively for aircraft, the flasher weighs 2.1 lbs., can be operated at either 12 or 24 volts, and has withstood a 65°C. test. It was built to conform with C.A.A. safety regulations, which require commercial aircraft to replace the one white taillight with white and red lights flashing alternately. Each cycle—there must be 40 per min.—consists of 150° of white light, 10° of no light, 150° of red light, and 50° of no light. The flashing switches safely handle 6 amp. in each circuit. This power will supply three 12-volt, 32-cp. lamps or six 24-volt lamps. As a safety precaution, should the driving motor slow down or stop, a double-throw switch is actuated so that a continuous white light shows. Pacific Division, Bendix Aviation Corporation.

Plastic Surface Protective Coating

Protecto-Kote is a liquid coating developed for the purpose of guarding plastic surfaces in airplanes during fabrication. It is stated that this coating dries rapidly; protects the surfaces from scratching and abrasion; is impervious to grease, paint, and paint solvents; but is water soluble. It is used on such aircraft parts as plastic window lights and plastic instrument panels. Reserve Research Company, Cleveland.

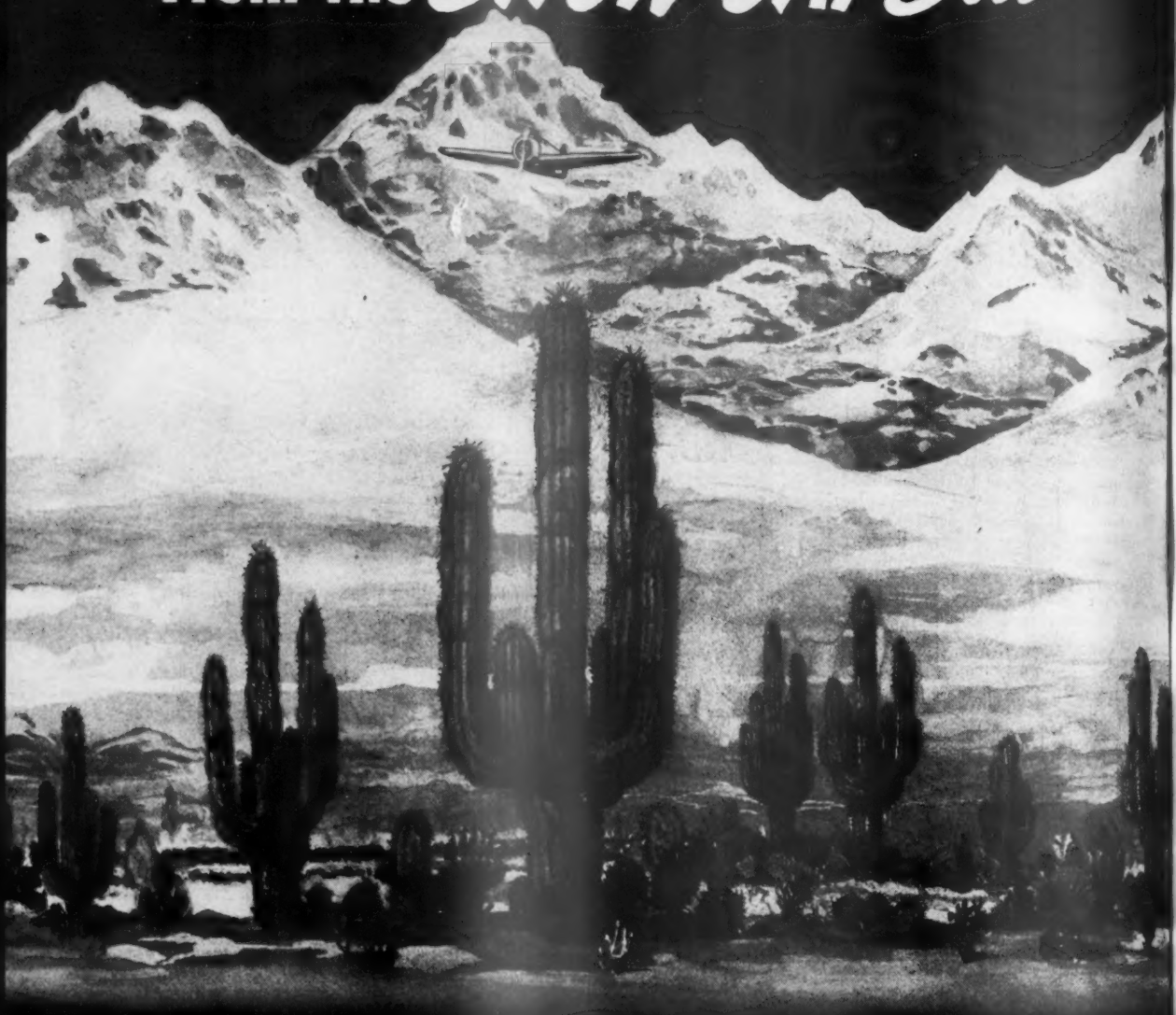
Dial-Indicator Snap Gauge

The improved Sheffield dial-indicator adjustable snap gauges are intended to fill the gap between the conventional snap gauge and the high-precision visual gauge. They are available in twelve models, covering a range up to 12-in., with larger sizes supplied according to specifications.

One of the most important applications of dial-indicator snap gauges is checking work as it is being brought down to size, enabling an operator to make a comparator type of check without removing work from the machine. The gauge is also frequently used for inspecting a finished part at the bench and for classifying parts of such size or weight as cannot be checked with other types of comparators. It has a large, shock-proof dial indicator 2¼ in. in diameter, graduated in tenths (0.0001 in.). It is of the balanced type, ±0.005 in., and the range per revolution of the hand is 0.010 in. When properly set, the hand will make 1¼ revolutions in either direction, the total range of the indicator being 0.025 in.

The makers state that the anvils are ground and lapped to a close tolerance, and the movable anvil is spring-urged and operates independently of the indicator spindle. The adjustable anvil has a maximum range of 1 in., which enables the gauge to be used on a number of different-sized work parts. The backstop is formed with a cylindrical radius permitting the gauge to be presented to the work at angles other than 90° to the axis of the part without impairing the

From the SNOW CAPS...



to the CACTUS

That will be your range when you fly your own plane after Victory is won—a week-end of skiing or hunting in the North—bathing or a round of golf in the sunny South. Business and pleasure trips will be made in a fraction of the time now required. Planes will be safe and easy to fly—engines will be economical and dependable—and age will be no barrier to anyone desiring to own and fly a personal plane.

We still face a big job before all this is possible, but if each of us does his utmost for the War effort, Victory will come—and freedom to come and go will be ours once more.

Yes, after the War you will have a plane—an efficient, safe plane—that will take you and your family wherever you want to go. For utmost reliability, with economy, decide today that your plane of tomorrow will be powered by a dependable, easy-to-service Jacobs Engine—like those now training more bomber pilots than all other engines combined.

JACOBS AIRCRAFT Engines

POTTSTOWN, PENNSYLVANIA, U. S. A.

accuracy of the reading. The backstop is adjustable to a varied degree on each size of gauge. The Sheffield Corporation Dayton, O.

American Glider Altitude Record

The Soaring Society of America has announced a new American altitude record for single-place sailplanes, bettering the previous record by 2,000 ft. Shelley Charles soared his sailplane "Minimoa" to an altitude of 19,434 ft. above the point of release over Atlanta, Ga.

The take-off was made from the Atlanta Airport on July 18, 1943, by means of an airplane tow, from which the glider was released at an altitude of 1,000 ft. The pilot encountered severe conditions involving rain, lightning, and ice, passing through a thunderstorm and extremely turbulent air. The announcement was delayed by the time necessary to certify the record. The Soaring Society of America, Elmira, N.Y.

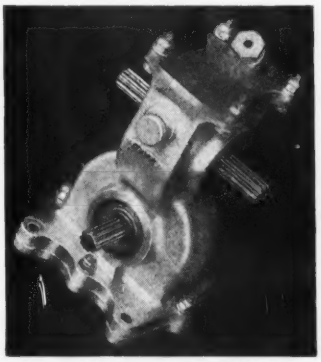
Conductive-Rubber Gun-Heating Pads

Conductive-rubber gun-heating pads for machine guns and aerial cannon are intended to keep the plane's armament at proper firing temperatures at all times. They make possible preheating of gun breeches while the plane is grounded and maintain required temperatures for instantaneous use at high altitudes. Heating is a means developed to prevent the jamming of these automatic guns resulting from the effects of sub-zero temperatures. While this heater has been designed and manufactured expressly for 0.50-caliber machine guns, the principles embodied in the construction of conductive rubber make it possible to employ this material successfully on guns and cannon of larger caliber.

The heating pad is simple in construction. It consists of a cotton fabric impregnated with a special synthetic-rubber compound that acts as the conductor. Two ordinary bare copper wires carry power to opposite sides of this fabric, and the resistance of the material generates the heat. The whole unit is covered with a synthetic rubber, which insulates the pad against outside short-circuit. Current is supplied by the plane's generators, which are connected to the pad by a standard aircraft coupling. A lock joint on the coupling is so constructed that the contact between the lock joint and the power-feed line can be turned on or off only by the operator of the gun. The lock joint prevents current failure through the accidental disconnection of the joint to the feed line.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

The heater pad is cemented to the side of the breech of the gun with a specially developed rubber cement. It is then rolled until complete bonding is accomplished. Once bonded, the unit remains attached to the gun breech irrespective of the degree of heat generated by the gun or the unit itself. Tests conducted under actual sub-zero flying conditions are reported to have proved that the heater is efficient at temperatures lower than −20°F. The unit is operated on low voltage and produces temperatures ranging from 30° to 200°F., depending on operating conditions. The total weight of the heating unit for a 0.50-caliber gun is less than 3 oz. United States Rubber Company.



The Vard lightweight gear box.

Gear Boxes for Plant and Plane

The Vard lightweight gear box, featuring simplicity of construction, was first designed for use on aircraft as a junction box for manual emergency operation of a line shaft. It has also been found useful industrially. The drive may be used under conditions where no gear reduction is necessary. It is designed for horizontal mounting and may be connected either parallel or at right angles. The distance between the centers of shafts in this gear box is $2^1/_2$ in. The attachment shafts are supplied with a 24–48 pitch, 11-tooth involute spline with a 30° pressure angle and a pitch diameter of 0.4583. It is designed for a maximum torque of 900 in.lbs. Vard, Inc., Pasadena, Calif.

Carbon-Pile Voltage Regulators

Information has been released about a new, high-voltage regulator known as the VR-2200 Series. These carbon-pile voltage regulators, developed for aircraft applications, are designed to dissipate 300 to 400 per cent more power than previous designs, occupying the same chassis space with 8 per cent less cubic volume and being only 6 per cent heavier.

Many different applications are possible. In one, the resistance of the carbon pile is in one side of the line and the regulator operates to vary this resistance automatically so as to produce constant voltage across the load. In another typical application, the voltage regulator varies the field excitation of an inverter, alternator, or special dynamotor in such a manner as to produce constant output voltage across the load. Where the machine is delivering a.c., a rectifier may be provided to supply the regulator solenoid circuit.

The VR-2200 Series units will handle 100 watts in the pile with an airflow through the fins of approximately 26 cu.-ft. per min. and up to 50–75 watts without air blast. Piles can be provided with a resistance range of the order of 20 to 1, the total range of maximum values being from less than 1 ohm to about 100 ohms. Webster Products, Chicago.

(*Continued from page 158*)

Aerobatics Simply Explained, by Wing Comdr. R. Cravell; Sir Isaac Pitman & Sons, Ltd., London, 1943; 40 pages, 9*d*.

In this book for service pilots the various kinds of flight maneuvers and how to carry them out are described. The author explains the practical reasons for learning aerobatics and the application of experience and skill developed through aerobatics to the work of the combat pilot. The precautions to be taken before attempting aerobatics are emphasized, after which instructions are given for each individual maneuver.

Handbook of Technical Instruction for Wireless Telegraphists, by H. M. Dowsett and L. E. Q. Walker; Iliffe & Sons, Ltd., London, 1943; 664 pages, 30*s*.

The seventh edition of a text for marine operators and others requiring information about the general principles and practice of wireless communication has been revised and enlarged. In addition to general theory, it gives practical information regarding the erection and maintenance of radio apparatus. The many types of equipment for marine application are described in detail.

With their lives...

our fighting men depend on the micro-inch accuracy and unfailing strength of vital parts in planes, ships, tanks and guns. Prominent among these parts are millions of Hyatt Roller Bearings... guarding against friction and power losses... guarding against losses of things that are precious to every American

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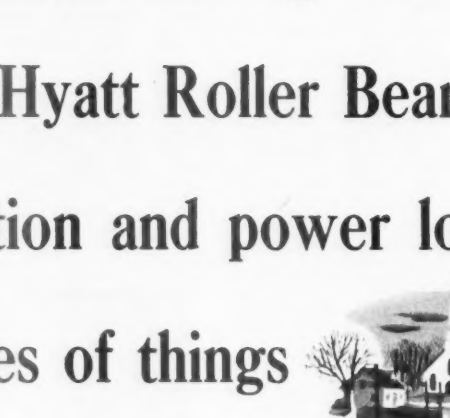
WHEREVER GEARS, SHAFTS, AND WHEELS TURN

HYATT BEARINGS  DIVISION OF GENERAL MOTORS

HYATT BEARINGS DIVISION · GENERAL MOTORS CORPORATION · HARRISON, NEW JERSEY

Institute News

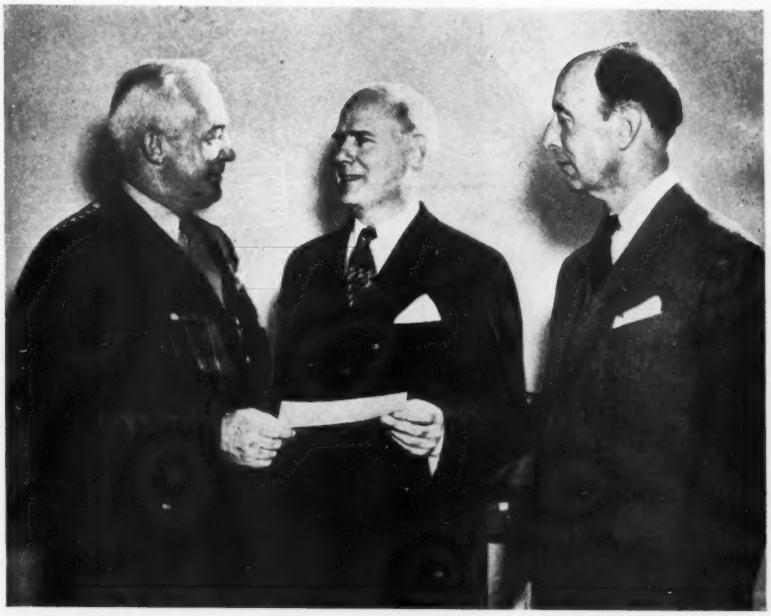
Orville Wright Dinner Proceeds to Air Fund

A check for $3,243.16, representing the net proceeds from the dinner to Orville Wright on the occasion of the Kitty Hawk Fortieth Anniversary ceremonies in Washington, has been given to Gen. H. H. Arnold, Commanding General of the Army Air Forces, for the Army Air Forces Aid Society, by Robert H. Hinckley, assistant to the president, Sperry Corporation, who was chairman of the committee on arrangements.

In making the presentation, Mr. Hinckley told General Arnold that Mrs. Arnold, who is vice-president of the Army Air Forces Aid Society, had suggested that the check be presented as a memorial to Wilbur Wright.

Lester D. Gardner, treasurer of the committee, reported that 805 dinner tickets had been sold, grossing $8,050. Refunds to those requesting them amounted to $340 with net receipts of $7,710. With expenses of $4,466.84, the balance available for presentation to the Army Air Forces Aid Society was $3,243.16, although Mr. Gardner said that there would be some additional receipts from the sale of the souvenir programs and that these receipts would be added to the Wilbur Wright Memorial donation.

The Committee in charge of the dinner to Orville Wright in Washington consisted of Hon. Jesse Jones, chairman; Hon. Robert A. Lovett; Hon. Artemus L. Gates; Hon. L. Welch Pogue; W. A. M. Burden; Dr. J. C. Junsaker; Thomas A. Morgan; Gill Robb Wilson; Col. Edgar A. Gorrell; James P. Murray; Lester D. Gardner, treasurer; and Robert H. Hinckley, chairman, committee on arrangements.



Gen. H. H. Arnold, Commanding General of the Army Air Forces, accepts a check for $3,243.16 for the Army Air Forces Aid Society, as a memorial to Wilbur Wright, from Robert H. Hinckley (center), chairman of the committee on arrangements of the Kitty Hawk Fortieth Anniversary Committee, as Robert A. Lovett, Assistant Secretary of War for Air, looks on.

Gifts to the Aeronautical Archives

W. A. M. Burden gave the original maps, charts, and drawings used in his book, *The Struggle for Airways in Latin America*, published in 1943. A portfolio of prints of American military airplanes in the air was received from the artist, Charles H. Hubbel, of Thompson Products, Inc., to add to previous gifts. Six Christmas cards designed for the Royal Canadian Air Force were received from Squadron Leader H. H. Booth.

Prof. F. N. M. Brown, of the University of Notre Dame, gave insignia of the Chinese Air Force, with a chart of the insignia worn on shoulder and sleeve and six samples of Chinese wood for aircraft. Insignia of Northrop Aircraft, Inc., and two aeronautical ashtrays were received from Jack Northrop.

A complete file of the first 48 issues of *Bradshaw's International Air Guide*, from November, 1934, to October, 1938, was given by R. W. Riis. The British Air Commission in Washington 119 sent *R.T.P. Translations* to add to the collections previously given. The United Air Lines Transport Corporation sent a large poster and several brochures celebrating the fortieth anniversary of the Wright Brothers' first flight. Mrs. Bella C. Landauer added music and relics to the large collections previously given.

Technical Sessions of the Twelfth Annual Meeting

As the Review has had to limit itself in the amount of paper used each month, this issue could not include the abstracts of the papers given at the Twelfth Annual Meeting.

The April issue of the Review will give a full account of the meeting, specially prepared by Dr. Alexander Klemin of New York University.

POINTERS ON PLANES . . . . . *No. 2 of a Series*

ELECTRONIC TUBE
DURAMOLD ELECTRONIC METHOD OF POLYMERIZATION BONDS SPARS IN 20 MINUTES—
Ordinary gluing method takes 8 hours

Electronics Now Used in Making Aircraft Spars

Fairchild's Duramold engineers have harnessed the electron to a new and urgent task—the manufacture of spars, backbones of our airplanes.

Usual plywood techniques for joining thin layers of wood could not be applied in making heavy wooden aircraft components. New methods were needed and *in a hurry*.

Fairchild engineers found the solution in electronic energy, employing radio high frequency with an apparatus similar to that used by radio stations in sending out short wave broadcasts but designed specifically for heating the plastic adhesives efficiently.

Heat generation by radio frequency, coupled with the use of special plastic adhesives, now turns out better, stronger spars. Production time has been reduced from hours to minutes. The use of electronics has become standard procedure in this phase of Fairchild's Duramold process for building plywood structures—another instance of how Fairchild engineers apply "the touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland....Burlington, North Carolina

A name plate of a Dayton-Wright Airplane Company Model DH4, of the first World War, was received from William B. Zint. Three cartons of aeronautical periodicals were received from the National Aviation Corporation. Two copies of a selective subject index to aeronautical periodicals for 1943 were sent by the Parks Air College Library, Willard Kelso Dennis, Librarian. Hugh Allen, of Southbridge, Mass., gave 110 issues of aeronautical periodicals. Volumes 1 through 4 of the *Flagship News* were received from American Airlines. An advance copy of Gen. H. H. Arnold's *Report of the Commanding General of the Army Air Forces to the Secretary of War* was received from Headquarters of the Army Air Forces, through Lt. Col. Robert H. Harper. Nine "Joe Dope" posters and several mailing labels were sent by the Office of the Chief of Ordnance. Felipe Echaniz, of the Pan American Airways System, gave a copy of his report on the *Estimated Future of Commercial Air Traffic in the United States.*

Among the donors of other gifts were the Aero Medical Laboratory at Wright Field; Air Transport Association of America; British Information Services; Congressional Committees on Appropriations, Claims, Interstate and Foreign Commerce, Postwar Economic Policy and Planning, and Printing; Captain Burr Leyson; National Bureau of Standards; Navy Department; Office of Civilian Defense; Plastics Catalog Corporation; Technical Data Section at Wright Field; and Transcontinental & Western Air, Inc.

Corporate Member Adopts New Title

The name of Fairchild Aviation Corporation has been changed to Fairchild Camera & Instrument Corporation. The change was made because the board of directors felt that in view of the present business activities of the corporation, consisting primarily of the manufacture and sale of precision instruments and equipment, the old name was not descriptive.

Sections and Branches

Detroit Section

The regular monthly dinner and meeting of the Detroit Section was held at the Horace H. Rackham Educational Memorial on October 13. A lecture was given by Kenneth D. Randall, Director of Engineering Production, Stinson Division, Consolidated Vultee Aircraft Corporation. The subject was "Art in Preliminary Aircraft Design."

On November 3, the members attended an illustrated lecture on "Aircraft Materials and Standards," by Albert M. Stutz, Material and Process Engineer, Consolidated Vultee Corporation. The meeting was preceded by a dinner.

I.A.S. National Light Aircraft Meeting

The Horace H. Rackham Educational Memorial

Detroit, Michigan April 27–28, 1944

A program of technical papers will be presented during the afternoon and evening of each day.

Members of the Institute, their guests, and others interested in the progress and development of light aircraft are invited to attend.

There will be no registration fee for members of the Institute. A registration fee of $1.00 will be charged for nonmembers for the entire four sessions.

Thursday, April 27

1:00 P.M.

Chairman: *Peter Altman*
Consulting Engineer

Specialized papers on structures and design, with particular reference to postwar requirements, will be given. Among the subjects to be discussed are: "Wing Flaps in Light Aircraft Design," "Unit Cabins to Increase Comfort of Light Aircraft," and "Predictions of Longitudinal Dynamic Stability."

7:00 P.M.

Chairman: *James W. Kinnucan*
Continental Aviation Engineering Corporation

Power-plant and propeller problems will receive particular attention in this session. Several of the papers to be presented are: "An Approach to Inlet Manifold Tuning for Increased Power," "Packaged Power," and "Analytical Investigation of Problems Concerning the Flow of Cooling Air in Light Airplane Engine Installations."

Friday, April 28

1:00 P.M.

Chairman: *William B. Stout*
Stout Research Division, Consolidated Vultee Aircraft Corporation

The progress and development of instruments and accessories for light aircraft, with special reference to future needs, will be reported. Some subjects will be: "What Instruments for the Light Plane?" "Lightweight Magnetic Direction Indicator," "Suggestions Furthering Private Flying," and "Flaps and Retractable Gear."

7:00 P.M.

Chairman: *Arnold M. Kuethe*
University of Michigan

A program of general engineering interest will include: "Flight Strips," "Motogliders—A Natural Link Between Gliders and Light Planes," "Regulation of Light Aircraft Design and Operation," "Airworthiness Requirements—Their Principles and Application," and "The Bell Helicopter."

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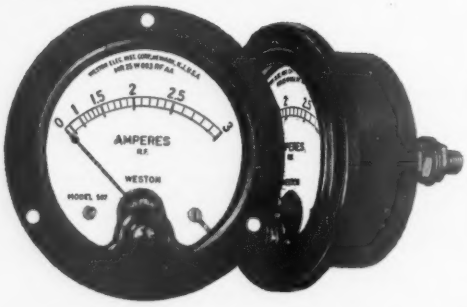

Types **MR25-MR24,** in Weston Models 506-507-517, in all listed combinations in American War Standard C 39.2 — 1944

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per AWS C 39.4—1943..
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Types MFA—MFB—MFC...
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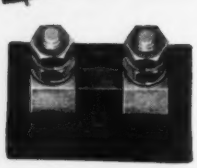

SHUNTS
Types MSA—MSB—MSC...
per AWS C 39.5 — 1943
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At a meeting on December 15, Dr. Edward P. Warner spoke on "Air Transportation Prospects" before a joint meeting of the Detroit Section and The Engineering Society of Detroit. The meeting and dinner, which was the fourth joint program in the past 2 years, were attended by more than 700 members.

The first meeting for 1944 was held on January 5. Waldo Waterman, Stout Research Division, Consolidated Vultee Aircraft Corporation, spoke on "Roadable Airplanes of the Past and Future." The lecture was illustrated by motion pictures. A second meeting for January was held on the nineteenth when Lt. Col. Leslie Gordon of the Army Air Forces presented the film, *War Department Report*. Following the showing of the film, Prof. A. M. Kuethe gave a brief résumé of the Wright Brothers' lecture.

San Diego Section

At a meeting of the San Diego Section on November 19, 1943, the election of the following Section officers was announced: E. G. Stout, Chairman; J. M. Whitney, Vice-Chairman; F. J. Schnaubelt, Treasurer; F. W. Devlin, Corresponding Secretary; F. L. Thornburg, Recording Secretary. The following were appointed as committee chairmen: Jack Mason, Special Events; C. L. Blake, Papers Committee; E. C. Terry, Membership Committee; V. F. Richards, Meeting Committee.

W. H. Curtis, West Coast Resident Engineer for Thompson Products, Inc., presented a paper on "Altitude Vapor Formation in Aircraft-Fuel Systems."

Seattle Section

A meeting of the Seattle Section was held on January 12, 1944. The speaker was Frank Disch, Boeing Aircraft Company, Engineering Division, who discussed "Fundamentals of Aircraft Engine Performance." This was the first of a series of talks planned to acquaint the aircraft engineer with subjects with which he may normally be associated.

The Aeronautical University, Inc.

A meeting held on January 17, 1944, was addressed by Lt. Luis Alfredo Sepulveda, a member of the Institute and a pilot and engineer of the Chilean Air Force. He gave a report on his thesis, "Jet and Rocket Propulsion."

North Carolina State College

The first meeting of the Winter Term was held on January 11, at which officers were nominated for the forthcoming year. On January 25 new officers were elected as follows: Chairman, T. B. Whitehurst; Vice-Chairman, S. B. Burwell; Secretary-Treasurer, F. R. McDavid; Recording Secretary, F. C. Witten. R. E. Allison was appointed Alternate Representative to the Engineer's Council, and G. S. George was designated as Reporter.

University of Oklahoma

A talk on "Aircraft Propellers," illustrated by a motion-picture film, was given by Herbert Woods at a meeting on November 25, 1943. On January 6, 1944, a film about the Officers' Candidate School and another depicting the bombing of the "Lexington" were shown.

Stanford University

The program for the meeting on December 15, 1943, included talks by two guest speakers. Charles Frick of the Ames Aeronautical Laboratory of the N.A.C.A. spoke on the activities of the laboratory and the opportunities which it offers to the graduate engineer. This was followed by a lecture by Lt. Comdr. Lee Prior of Moffett Field on the subject of "Aircraft Power Plants."

Another meeting was held on January 19, at which a talk was given by G. H. Stocker, Chief Meteorologist of the San Francisco base of United Air Lines, on meteorology and its application to aeronautics.

University of Texas

At a regular meeting on January 19, the program included the showing of three motion pictures: *The Life and Death of the Hornet*, *The Battle of Midway*, and *Divebomber*.

News of I.A.S. Members

Warren M. Ballard is now associated with the Ballard Aircraft Company, Inc.

Albert C. Ballaseyus has joined the Aircraft Division of the Bechetel-McCone-Parsons Corporation as a Senior Engineer.

Preston R. Bassett has been appointed Acting General Manager of the Sperry Gyroscope Company. He is also Vice-President in Charge of Engineering.

Charles H. Brunnell has left Goodyear Aircraft Corporation to become a Liaison Engineer in the Chicago plant of the Douglas Aircraft Company, Inc.

Paul J. Burchett is now a Field Engineer for the Douglas Aircraft Company, Inc.

Rowland Burnstan is the new President and General Manager of the Lawrence Aeronautical Corporation.

Ricardo R. Claisse is a Master Mechanic with Transportes Aereos Centro Americanos.

Donald M. Cole, Jr., has been commissioned a Captain in the U.S. Army Air Forces.

Gwynn Crowther, Jr., has become a Senior Stress Analyst for the Eastern Aircraft Division of General Motors Corporation.

Carl P. Dowell has received his commission as Major in the Air Service Command of the U.S. Army Air Forces.

William N. Dreyer is now an Ensign in the U.S. Navy.

William R. Enyart was advanced to the presidency of the National Aeronautic Association for the unexpired term of Gill Robb Wilson, ending June 30.

Robert G. Feldman was commissioned a Second Lieutenant in the U.S. Army Air Forces.

James E. Glauser has joined the Aeronautical Division of the Pacific Scientific Company.

Everett Hannifin has entered the U.S. Army Air Forces.

William R. Hardin has received his commission as an Ensign in the U.S. Naval Reserve.

Leo B. Kimball has joined Commonwealth Aircraft, Inc.

Charles L. Lawrance has assumed the duties of Director of Engine Research for the Lawrance Aeronautical Corporation in addition to his position as Chairman of the Board of Directors.

Robert B. Lea has been elected Deputy Vice-Chairman of The Economic Development Council of the Aeronautical Chamber of Commerce.

Wayne E. Leutloff is now a Lieutenant in the U.S. Navy.

Neil MacCoull has been commissioned as a Lieutenant Commander in the U.S. Navy.

Charles E. Mathews was elected Vice-President of Taca Airways.

Lawrence C. Maugh has been appointed Assistant Professor of Civil Engineering at the University of Michigan.

Lewis E. Reisner has been put in charge of the subcontracting business of Tennessee Aircraft Company, Division of General Aircraft.

Clifford P. Seitz was commissioned a Lieutenant in the U.S. Naval Reserve.

John S. Smith has been elected Deputy Vice-Chairman in charge of Liaison activities of The Economic Development Council of the Aeronautical Chamber of Commerce.

Max Sokol has assumed the duties as Head of the Analytical Section of the Columbia Aircraft Corporation.

Francis P. Somers was commissioned a Lieutenant Commander in the U.S. Navy.

Adam K. Striker, Jr., is now the Head Industrial Engineer for the Signal Corps of the War Department.

Charles F. Taylor is acting as Engine Consultant for the Engineering & Research Division of Lawrance Aeronautical Corporation.

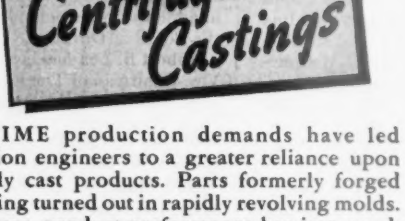
Irving H. Taylor was appointed Chairman of The Economic Development Council of the Aeronautical Chamber of Commerce.

Carl J. Wenzinger has been commissioned Lieutenant in the U.S. Naval Reserve.

Gill Robb Wilson resigned as President of the National Aeronautic Association to become Aviation Editor of the *New York Herald Tribune*.

New Uses for SHENANGO-PENN *Centrifugal Castings*

WARTIME production demands have led aviation engineers to a greater reliance upon centrifugally cast products. Parts formerly forged are now being turned out in rapidly revolving molds. In many cases, product performance has improved; in all cases, finished production time has been reduced and critical materials have been conserved.



Shenango-Penn castings can probably be used wherever wheels turn or where wearing or corrosion exist. Because the process is so flexible, it is possible to furnish flanges and to work out unusual shapes and sizes. Our standard alloys meet all Army, Navy and Air Corps specifications—and are constantly tested and checked in our own laboratory.

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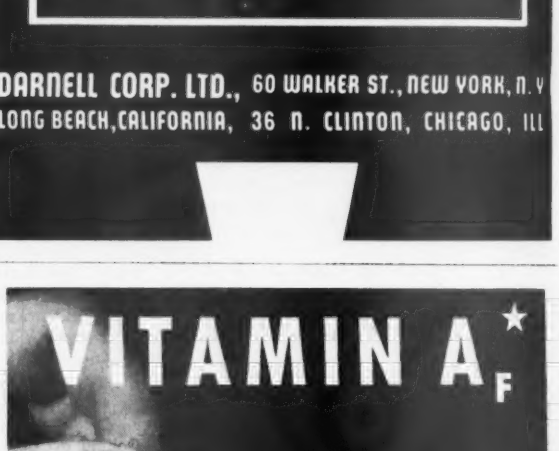

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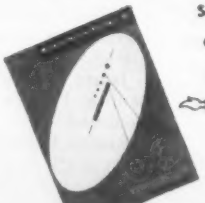


* *The anti-friction Vitamin*

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated.

Transferred to Associate Fellow Grade

Arnhym, Albert Alexander, M.S.; Consulting Engineer, Solar Aircraft Co.

Elected to MEMBER Grade

Blamphin, Arthur Merrick, B.S. in C.E.; Lt. Comdr., U.S. Navy, Head of Materials Section, Equipment & Materials Branch, Engineering Div., Bureau of Aeronautics.

Blanck, George Melville, Armament Group Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Dobson, Richard Nesbitt, B.M.E.; Asst. Chief Engineer, Canadian Car & Foundry Co. Ltd., Canada.

Doyle, John E., Stress Analyst, The Glenn L. Martin Co.

Hajek, Raymond Rowland, Capt., U.S. Army Air Forces, Weight & Balance Control Officer, Air Transport Command.

Hart, James Crawford, B.M.E.; Executive, Taylorcraft Aviation Corp.

Hunter, Howard, Jr., B.Ae.E.; Flight Test Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Kling, Nelson George, Chief Engineer, Airex Mfg. Co., Inc.

McAlpine, Gustavus, Technical Adviser, Kelvin Bottomley & Baird, Ltd., England.

Mengert, Harold Austin, Executive Engineer, Stout Research Div., Consolidated Vultee Aircraft Corp.

Myles, Gwilym Leighton, Inspector, Hawker Aircraft Ltd., England.

Peskin, Leonard Clifford, Sc.D.; Products Engineer, Kellett Aircraft Corp.

Pocock, John William, M.S.; Asst. Chief Engineer, Armstrong Cork Co.

Sandler, Don Harvey, Chief Liaison Engineer, Consolidated Vultee Aircraft Corp.

Shomber, Kerian Judson, E.M.; Field Engineer, United-Carr Fastener Corp.

Spengler, Charles Joseph, B.S. in Ae.E.; Structural Test Engineer, Boeing Aircraft Co.

Steinau, Alfred Bertin, B.C.; Structural Project Engineer, Eastern Aircraft Div., General Motors Corp.

Stevens, A. Leo, Aero. Engineer, Switlik Parachute Co.

Summers, Maurice Francis, Wing Commander, Test Pilot, R.A.F., England.

Waldman, Jack Louis, I.E.; Chief Weight Analyst, Goodyear Aircraft Corp.

Werner, Henry August, B.S.; Armament Engineer, Group Leader, Consolidated Vultee Aircraft Corp.

Wolfe, Thomas, B.S.; Vice-Pres. in Charge of Traffic, Advertising and Publicity, Western Air Lines.

Yachter, Morris, M.Ae.E.; Project Aero. Engineer, Brewster Aeronautical Corp.

Young, H. Russell, B.S. in M.E.; Supervising Engineer of Wind Tunnels, Baldwin Southwark Div., The Baldwin Locomotive Works.

Transferred to MEMBER Grade

Dillon, Frederick Peter, Lt., Bureau of Aeronautics, U.S. Navy.

Jenny, Robert William, B.Ae.E.; Design Engineer, Development Div., Curtiss-Wright Corp.

Kantor, Maxwell, B.Ae.E.; Chief Project Engineer, Skydyne, Inc.

Korda, Eugene J., B.S. in E.; Head, Industrial Visual Aids Industrial Design, North American Philips Co., Inc.

Elected to Industrial Member Grade

Herring, Earl Rath, President, Kinner Motors, Inc., and Airplane Mfg. & Supply Corp.

Kratz, David Winston, Major, Pres., The Kratz Corp.

Russell, William Charles, Installation Engineer, Jacobson & Co.

Schwarzmuller, Clifford W., Asst. Project Engineer, Edo Aircraft Corp.

Elected to Technical Member Grade

Alexander, James George, B.S. in Ae.E.; Engineer, Design Dept., Cessna Aircraft Co.

Anderson, Charles A. R., B.E.; Stress Analyst, Sikorsky Aircraft Div., United Aircraft Corp.

Bates, Homer Jesse, B.S. in M.E.; Assoc. Aero. Engineer, Flight Test Branch, Flight Section, Wright Field.

Berman, Henry, B.S.; Structures Lab., Consolidated Vultee Aircraft Corp.

Brown, Jack Melvin, B.S. in Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Cheeseman, LeYork, Instructor, Transcontinent & Western Air, Inc.

Crocker, Gage Houston, S.B. in Ae.E.; 2nd Lt., U.S. Army Air Forces.

Davidkhanian, Ashod Samson, B.S. in C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

DeBin, Livio Anthony, Liaison Engineer, Fleet Aircraft Ltd., Canada.

Emmerson, George Philip, Group Leader, Fleet Aircraft Ltd., Canada.

Foss, Norman Horace, Sr. Layout Draftsman, Emerson Electric Co.

Gorman, Joe, B.S. in Ae.E.; Design Instructor, Aeronautical University, Inc.

Hassett, Robert James, B.S. in M.E.; Stress Analyst, The Glenn L. Martin Co.

Hayden, Harold Jerome, Structural Engineer, Boeing Aircraft Co.

Herreshoff, James Brown, M.A. in Physics, Stress Analyst, Engineering Div. (El Segundo Plant), Douglas Aircraft Co., Inc.

Kresse, Oscar Florenz, B.Sc. in Ae.E.; Aerodynamicist & Flight Engineer, Airplane Div., Curtiss-Wright Corp.

Milligan, Addison Sheffer, Jr. Layout Draftsman, Republic Aviation Corp.

Nierenberg, Abram Byron, B.S. in Ae.E.; Aero. Layout Draftsman, Brewster Aeronautical Corp.

Nestingen, Irvin M., B.Ae.E.; Sr. Aero. Engineer, Consolidated Vultee Aircraft Corp.

Nolan, James Robert, Hydraulic Group Engineer, Waco Aircraft Co.

O'Brien, William Andrew, B.S.; Draftsman, Bell Aircraft Corp.

Patterson, Raymond Thomas, B.S. in M.E.; Research Analyst, Factory A, Lockheed Aircraft Corp.

Pfarr, John Joachim, Design Engineer, Northrop Aircraft, Inc.

Wallach, Bernard, B.M.E.; Asst. Project Engineer, Sperry Gyroscope Co., Inc.

Wallis, Keith Lee, B.S. in M.E.; Stress Engineer, Boeing Airplane Co.

Warner, John M., B.Sc.; Technical Asst. & Flight Observer, Vickers-Armstrong Ltd., England.

Youngs, Wallace Irving, Asst. Electrical Engineer, Bell Aircraft Corp.

Transferred from Student to Technical Member

Brown, Charles Douglas, B.S. in Ae.E.; Apprentice Engineer, Pan American Airways System.

Bugielski, William Zygmunt, B.S. in Ae.E.; Jr. Engineer, Eastern Aircraft Div., General Motors Corp.

Burkam, John Elza, A.E.; Reserve Midshipman, U.S. Naval Academy.

Capitani, Albert, B.S. in M.E.; U.S. Army.

Carlin, John Joseph, Midshipman, U.S.N.R.

Cullen, Albert Joseph, B.S. in Ae.E.; Research Fellow, Polytechnic Institute of Brooklyn.

De Crappeo, Edward Salvatore, B.S. in Ae.E.; Stress Analyst, Eastern Aircraft Div., General Motors Corp.

Eaton, William Joseph, B.S. in Ae.E.; Apprentice Engineer, Pan American Airways System.

Edelstein, Murray Irving, B.S. in Ae.E.; Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Fitzpatrick, John Aloysius, B.Ae.E.; Engineer, Engineering & Research Corp.

Gardner, Elston Abbott, Test Engineer, Northrop Aircraft, Inc.

Giugno, Angel Blase, B.S. in Ae.E.; Service Engineer, Bendix Aviation Corp.

Hanson, Charles Arthur, B.S. in M.E.; Aerodynamicist, Boeing Aircraft Co.

Haywood, William McJohn, A.B.E.; Flight Analyst "B," Douglas Aircraft Co., Inc.

Hipkins, Jack Wilbur.

Hurc, Cass Frank, B.S. in Ae.E.; U.S. Army Air Forces.

Jones, George Nevitt, Jr., B.S. in Ae.E.; Designing & Detail Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Kassel, Henry Warren, B.S. in Ae.E.; Draftsman, Douglas Aircraft Co., Inc.

Kempner, Joseph, B.S. in Ae.E.; Research Asst., Polytechnic Institute of Brooklyn.

Kilmer, Melvin Daniel, B.S. in M.E.; Engineer, Douglas Aircraft Co., Inc.

Krebs, David Aaron, B.S. in Ae.E.; Jr. Engineer, Aeronca Aircraft Corp.

Kleissas, John, B.S. in M.E.; Minor Layout Draftsman, Consolidated Vultee Aircraft Corp.

Leadon, Bernard M., M.S. in Ae.E.; Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Lo Piccolo, Robert C., Ae.E.; Aviation Cadet, U.S. Army Air Forces.

On DEHAVILLAND MOSQUITOES, COMPAR *keeps hose lines flexible*

RESISTOFLEX hose lines on the famous DeHavilland Mosquito Bomber stay live and flexible . . . are permanently free from internal erosion, gumming or swelling . . . thanks to their inner surface of COMPAR.

In hundreds of hours of service in fighters, bombers and transports, this unique elastic plastic used in all Resistoflex aircraft hose assemblies has convincingly demonstrated its chemical inertness. It is completely impervious to lubricants, hydraulic fluids, gasoline, fuel blends . . . even those having the highest aromatic content. The COMPAR surface is glass-smooth, too, keeping skin friction and turbulence down to a minimum.

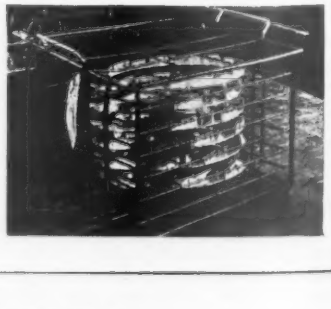
Resistoflex hose assemblies offer still other advantages for aircraft applications. They have high resistance to continuous vibration and flexing, withstand heavy shock loads. They are ounces lighter than other lines of similar construction, yet have much higher mechanical strength.

Resistoflex hose assemblies are supplied in all standard diameters and lengths for instrument and medium pressure hydraulic lines . . . meet applicable Army and Navy specifications. For full details, write for the Resistoflex Aircraft Catalog.

BASKET COATING PROTECTS PACKARD PARTS

Highly polished parts for Rolls-Royce aircraft engines move safely through machining departments at the Packard plant in wire baskets coated with COMPAR — the *same* elastic plastic that gives Resistoflex hose its unique qualities.

Parts can be degreased right in the baskets, for COMPAR is immune both to oil and to degreasing solvents. Supplied by Resistoflex Corporation in solution form, the coating is easily applied in the user's plant. Write for further information.



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LOW AND MEDIUM PRESSURE INSTRUMENT, HYDRAULIC AND VACUUM HOSE ASSEMBLIES — MANOMETER TUBING, DIPPED AND MOLDED SPECIALTIES.

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Loudermilk, James Grover, B.S. in Ae.E.; Liaison Engineer, Bell Aircraft Corp.

Maila, Edward William, B.Ae.E.; Detail Draftsman Trainee, Chance Vought Aircraft Div., United Aircraft Corp.

Minard, James Vernon, B.S. in Ae.E.; Midshipman, U.S.N.R.

Munroe, Rosferd Charles, Apprentice Engineer, American Export Airlines, Inc.

Olason, Lynn, B.S.; 2nd Lt., U.S. Army Air Forces, Experimental Engineer, Matériel Command.

Pendley, Robert Elias, B.S. in Ae.E.; Jr. Aero Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Pritchard, Raymond Ralston, B.S. in Ae.E.; Conduct Work, Georgia School of Technology.

Ready, Joseph Augustine, B.S. in Ae.E.; Grumman Aircraft Corp.

Robertson, David Fillmore, B.S. in Ae.E.; Aero. Engineer, The Dow Chemical Co.

Rosenberg, Morris, B.A.E.; Detail & Drafting, Chance Vought Aircraft Div., United Aircraft Corp.

Salisbury, Ralph Dewey, Jr., B.S. in Ae.E.; Draftsman "B," North American Aircraft, Inc.

Samuels, Barnett Jule, Staff Engineer, Fleet Aircraft Corp., Canada.

Shackleford, Stanley Leonidas, B.S. in Ae.E.; Ensign, U.S. Navy.

Shaw, Alan David, B.S.; Engineering Asst. "A," North American Aviation, Inc.

Soukup, Robert Julius, B.S. in Ae.E.; Strength Test Engineer, Douglas Aircraft Co., Inc.

Wittenbach, Adolph John, Jr., Aerodynamicist, North American Aviation, Inc.

Elected to Affiliate Grade

Echevarria, Albert Francisco, "A" Layoutman, Brewster Aeronautical Corp.

Richards, Herbert William, M.E.; Technical Asst., Pan American Airways System.

Necrology

William Benson Mayo

William Benson Mayo, Member of the Institute and former Chief Engineer of the Ford Motor Company, died on February 1 in the Henry Ford Hospital, Detroit, at the age of 78.

Born at Chatham, Mass., Mr. Mayo received his education in mechanical and aeronautical engineering through private instruction under tutors. For more than 30 years he was connected with the Hooven-Owens-Rentschler Company, of Hamilton, O., first as manager of the New York and Boston offices and then as factory manager and sales manager. He was chief engineer for 10 years and vice-president and general manager for 5 years.

He joined the Ford organization in 1913, designed the company's River Rouge works and various assembly plants, supervised the construction of the Ford ore-carrying ships, and was credited with having been largely responsible for the entry of the Ford Company into the aircraft industry. He resigned after 20 years with the Ford organization but retained connections with numerous aeronautical industrial, utility, and transportation companies as an officer or director, serving also on the Board of Street Railway Commissioners of Detroit and in other public offices. His public-service activities included memberships in several civic clubs and as a college trustee.

A lumarith plastic model used to train Army and Navy personnel in aircraft indentification. These are molded by the Cruver Manufacturing Company and are scaled down 1 to 7 in. The Institute has a display of over 225 such models of almost every Allied and Axis plane.

Marvin Ernest Walseth

Marvin Ernest Walseth, a First Lieutenant in the U.S. Army Air Forces, has been listed as killed, after having been reported missing in action. The date upon which he lost his life and the location were not announced. He was a Technical Member of the Institute.

Lieutenant Walseth was a native of Eagle Bend, Minn. While studying at the University of Minnesota, he worked in the University's Experimental Laboratories and was graduated with the degree of Bachelor of Aeronautical Engineering in 1937. He entered the Air Corps Flying School as a cadet and was commissioned in June, 1938, being assigned to the 19th Bombardment Group. He served at Ladd Field in Alaska and was reported missing in action from an overseas station.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

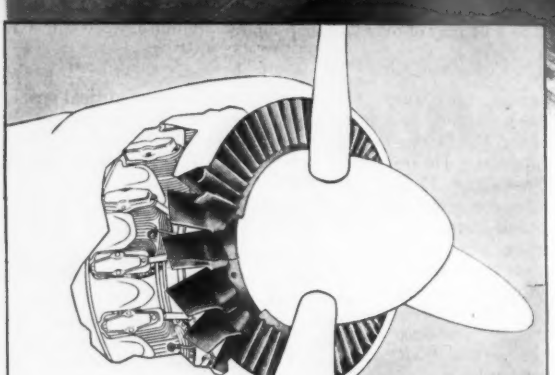
Aeronautical Engineers with two or more years' experience in structural design and layout, or stress analysts, those with experience in the light aircraft field preferred, are urgently needed by Consolidated Vultee Aircraft Corporation, Stout Research Division. Must be referred through U.S. Employment Service. Write giving full particulars to Executive Engineer, 22148 Michigan Avenue, Dearborn, Mich.

Aeronautical Engineer wanted for promotional work in expanding line of highly specialized equipment for aircraft, also airway and airport control tower equipment. Must have extensive background in aircraft instrumentation, know the pilot's problems and the requirements of the air lines. Good basic knowledge in aerodynamics, physics and electronics necessary. Engineering sales and service experience contacting air lines and aircraft manufacturers desirable. Apply Wallace & Tiernan Products, Inc., Belleville 9, N.J.

Stress Analysts, graduate, experienced; **Engineers,** Design and Development (Hydraulic-Thermodynamic, experience essential). American Citizenship required. Write or wire, Aerojet Engineering Corporation, Pasadena 1, Calif.

Engineer with wide background and experience to head Field Engineering

Cool 'em with FANS



DeBOTHEZAT LAMINAR FLOW PROFILE FAN with adjustable contravanes shown partially cut away and at minimum setting.

OUT OF OUR DeBothezat laboratories for aerodynamic research now comes a new type laminar flow profile steel fan wheel adaptable to air cooled aircraft engine cooling. Chief features would be to provide: *adequate and controlled cooling at all air speeds with reduced cowl flap drag—and increased effective horsepower.*

This fan unit may consist of adjustable contravanes and a fan wheel mounted directly behind the propeller. The adjustable contravanes provide controlled cooling at varying flight conditions.

This new fan development is the product of the engineering staff that successfully solved the problem of blast-cooling radial air cooled aircraft engines which are virtually "buried" in U.S. tanks.

DeBothezat's modern aerodynamic laboratories are ably staffed with skilled technicians experienced in solving numerous difficult engine cooling problems.

De Bothezat Division of

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Section; able to interpret engineering policies of the several divisions of the corporation to the users of its products; assemble engineering information from all outside sources that will apply in the making of engineering policy for these divisions. Must be a citizen and able to secure certificate of availability. Write particulars, giving draft status, to Mr. Dean C. Smith, Director of Development, Fairchild Engine and Airplane Corporation, 30 Rockefeller Plaza, New York 20, N.Y.

Engineers — Electrical — Mechanical—Aeronautical, for design, production and application work on fractional horsepower motors and mechanical devices. Plant located in city of 20,000 population adjacent to Dayton, O. Must comply with W.-M.C. regulations. Apply by letter giving education and experience to Lear Avia, Inc., Engineering Personnel Dept., Piqua, O.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen not employed in essential war industry or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Aeronautical Engineers urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicant must have technical training and not presently employed in essential war industries. Apply direct to 921 Lamar Street, Fort Worth, Tex.

Aircraft Engineers needed by a progressive aircraft company with openings for group engineers to cover hydraulics, landing gear, and controls. Also positions available for a materials and process engineer, service engineer, procedures engineer, and several aircraft checkers. Those presently employed in essential war work need not apply. Airmail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, draft status, in order that we may be able to evaluate your qualifications from the first letter. Higgins Aircraft, Inc., P. O. Box 32, New Orleans 6, La.

Aircraft Power Plant Engineer by leading Aircraft Accessory Manufacturer on exceptionally interesting and new developments, excellent possibilities for the future with company located in Ohio and California. Address inquiries to Box 206, Institute of the Aeronautical Sciences.

Engineers—Aeronautical, Mechanical or Electrical; good opportunity available for designing and project development work. Must be citizen not employed in essential war industry or have proper certificate of availability. Write, giving full particulars including draft status to Box 212, Institute of the Aeronautical Sciences.

AVAILABLE

Engineer and Pilot—B.M.E., Commercial Pilot, 1,020 hours, 0–440 hp., instrument and instructor ratings; 8 years' varied commercial experience, including instructing and engine test flying. Employed at present as engineer but can get full release for flying job. Desire position where engineering and flying can both be used but would be interested in a purely flying job. Address inquiries to Box 214, Institute of the Aeronautical Sciences.

Aeronautical Engineering Executive with 15 years' experience throughout the industry desires responsible executive position. Thoroughly indoctrinated in design, manufacture and service. Possibility of airline connection suggested. Address inquiries to Box 213, Institute of the Aeronautical Sciences.

Engineer, Graduate, Aeronautical, and commercial pilot, over 5 years' aircraft experience, including service as design, flight test, and project engineer, demonstration and check pilot, desires responsible position furthering use and expansion of this experience. Available April. Address inquiries to Box 211, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in A.E., with 10 years' experience in teaching Aeronautical Engineering and Engineering Mechanics, possesses valid A and E License. Desires position in University or Industry in South or Southwest. Address inquiries to Box 210, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Brazilian, M.S., M.I.T., returning home after a seven months' tour of the U.S. Aircraft industry, desires contact with companies interested in development of South American Market. Address inquiries to Box 209, Institute of the Aeronautical Sciences.

Aeronautical Engineering Executive, age 42, 9 years' experience in mechanical and structural engineering; 10 years' well-rounded experience in aircraft design, manufacturing and service engineering desires new connection with commercial aircraft manufacturer or air line as assistant chief engineer, chief designer or chief project engineer. Experience includes collaboration on both commercial and military aircraft. West Coast preferred but willing to consider other location. Address inquiries to Box 208, Institute of the Aeronautical Sciences.

Aeronautical Engineer recently discharged Army Air Forces, formerly executive Chief Engineer and Consultant, desires new connections either permanent or consulting. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in M.E. (Aero Option), with over 4 years' experience in design and supervision wishes to become associated with a consulting engineer or group in the Philadelphia area. Address inquiries to Box 202, Institute of the Aeronautical Sciences.

Graduate Engineer, 10 years' practical experience in design and development of aircraft armament including power-operated gun turrets; 50-caliber and 20-mm. fixed installations. Experience obtained with leading American and British Gun Turret Builders; desires position as Design Engineer or Executive with progressive aircraft concern. Address inquiries to Box 198, Institute of the Aeronautical Sciences.

Aeronautical Engineering Executive, Scottish born Canadian Citizen, age 42, 9 years' experience, all phases aircraft engineering; 10 years' mechanical engineering; 5 years' electrical engineering; 4 years' marine engineering; desires responsible executive position; immediately available, willing to work anywhere in United Nations territory. Address inquiries to Box 195, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer, 20 years' military and commercial aircraft engineering, including design supervision, liaison, and coordination. Desires responsible project or position as engineering representative on large cargo planes. Draft status does not effect change. Available in 30 days. Address inquiries to Box 194, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer, fifteen years' practical and well-rounded experience in design supervision and executive, wide organizational and creative background as Project Engineer, Chief Design Engineer, Assistant Chief Engineer. Release granted. Desires permanent position in the design or manufacturing branch. Willing to go into partnership. Location prefered, Los Angeles extended area or South America. Address inquiries to Box 153, Institute of the Aeronautical Sciences.

Grinding mills used to reduce ore to appropriate size for treatment

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Weapons for war get their start underground.

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Through research and development work in the pre-war years, manufacturers have pioneered many innovations that make today's mining equipment amazingly efficient.

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